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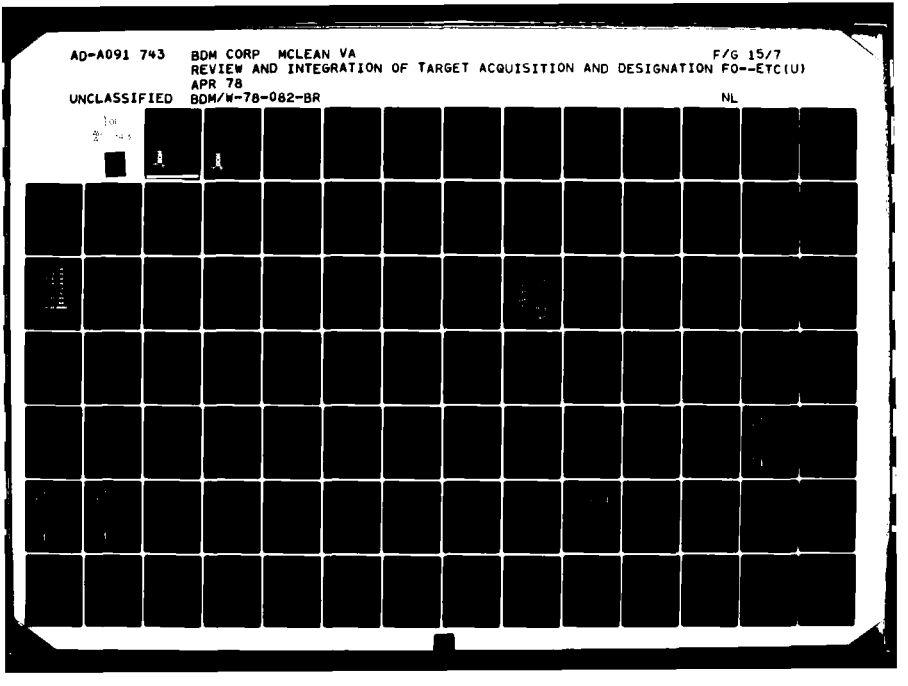

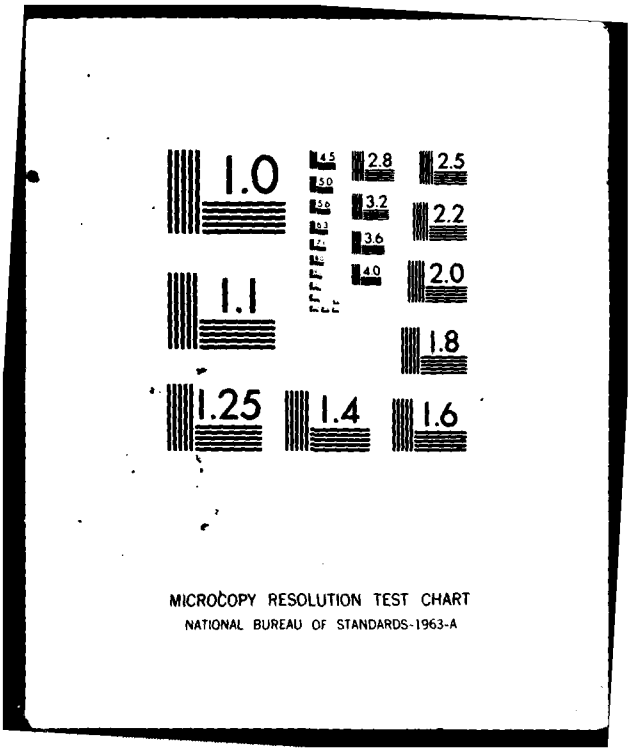

THE BDM CORPORATION

REVIEW AND INTEGRATION OF TARGET ACQUISITION AND DESIGNATION FOR ARTILLERY ATTACK OF ARMOR

(2)

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REVIEW AND INTEGRATION OF TARGET ACQUISITION AND DESIGNATION FOR ARTILLERY ATTACK OF ARMOR

(9) This Final Report is submitted to the U.S. Army Development and Readiness Command, Battlefield Systems Integration Directorate, 5001 Eisenhower Avenue, Alexandria, Virginia 22333

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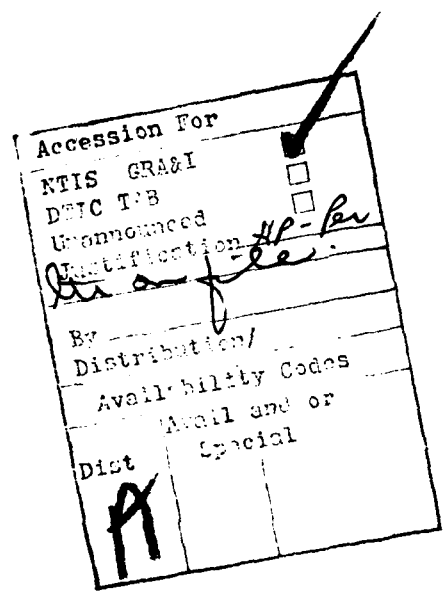
FOREWORD

This study on the 'Review and Integration of Target Acquisition and Designation for Artillery Attack of Armor' is presented by The BDM Corporation to the U.S. Army Development and Readiness Command, Battlefield System Integration Directorate. The work is divided into two parts with the first presenting the unclassified study results and the second containing the classified (confidential) annex.



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SUMMARY

CHAPTER I

SUMMARY

A. OVERVIEW

The Battlefield Systems Integration Directorate of the Army Materiel Readiness and Development Command (DARCOM/BSI) requested that The BDM Corporation review and analyze three artillery related problems:

(1) The integration and coordination of target acquisition and designation resources for artillery attack of armored systems in Zone I,

(2) The same review and analysis for Zone 2, as for Zone I, and

(3) The ammunition requirements for conventional artillery ammunition fire against area targets normally found on the modern battlefield.

For the purpose of accomplishing Tasks I and 2, target acquisition and designation resources were defined as being: standoff target acquisition system (SOTAS), remotely piloted vehicles (RPVs), the advanced scout helicopter (ASH), a forward observer with a ground laser locator designator (GLLD), a forward observer without a ground laser locator designator, REMBASS sensor items, and ground surveillance radars. Early in the research effort, it was determined that the current organization of the ground artillery locating and designating teams now called Fire Support Teams or FIST appear to be very efficient units. These units had only recently been designed to:

(1) Optimize fire support resources available,

(2) Improve the combined arms training, and

(3) Facilitate fire support coordination.

If these teams had a ground/vehicular laser locator designator (G/VLLD) they could adequately support the maneuver company in the majority of the combat conditions. Additional ground laser locator designators in the FIST team would appear to only complicate the control function of the maneuver company in delivering anti-armor fire in Zone I on the targets. Further, it was determined that the most critical Zone I artillery problem was the attack of armored targets if the direct

fire forces are being smoked by the enemy's artillery fire. In this case the FIST team, as well as the ASH with a designator, would be inhibited in supporting the operation. The most likely method for delivery of highly efficient anti-armor artillery fire in this instance would be to use RPVs to designate for the Cannon Launched Guided Projectiles (CLGPs).

The ground surveillance radar plays an important role with the FIST team in coordinating artillery fire in Zone 1, given bad weather. The current procedures for coordinating ground surveillance radar target acquisition function through the FIST team to the artillery delivery unit for delivery of high explosive (HE) fragmentation and dual purpose improved conventional munitions (DP-ICM) were adequate at this time and were not addressed further in this study.

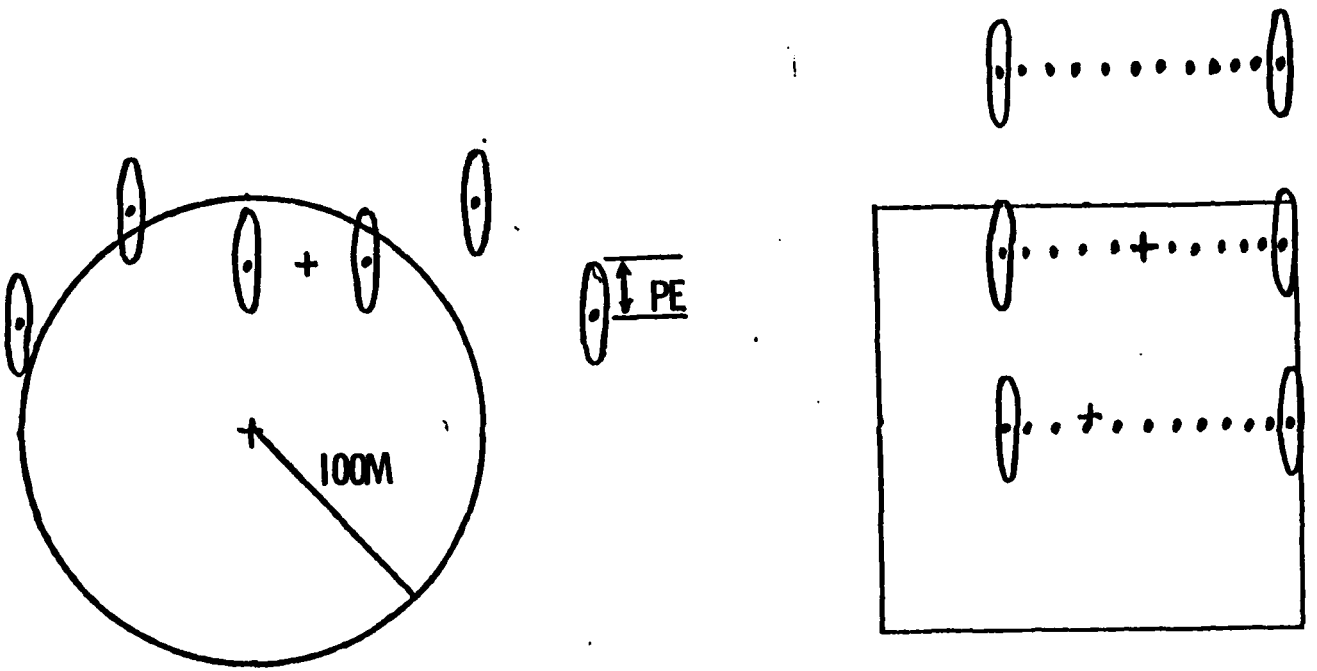
As a result of previous Department of the Army and BDM research efforts, emphasis was placed on delivery of anti-armor artillery delivered fire power in Zone 2 in this study. To accomplish this Zone 2 mission one of the critical elements was defined as being a moving target indicating set of system. The systems selected initially to be used were the SOTAS and the REMBASS set of ground based sensors. The SOTAS system was used for the majority of calculations and interface function evaluation during this scenario, even though REMBASS could have performed similar type functions. The second major element in the Zone 2 artillery attack of armor systems was the RPV with a laser locator designator and both daytime and nighttime target acquisition capability. The third element of the Zone 2 artillery attack system was the CLGP/COPPERHEAD and its 155mm direct support artillery organization. The majority of this research effort concentrated on this Zone 2 artillery attack of armor problem.

The third task in the BDM research was to take a preliminary look at the fire support effectiveness when firing against area targets. This analysis had been requested because of the previous work that The BDM Corporation had done in reviewing the Fendrikov Artificial Dispersion Methodology of the Soviet Union with the U.S.A. Joint Munitions Effectiveness Manual solutions. Preliminary results had indicated a substantial savings by using artificial dispersion over firing parallel sheaf, which was the most common technique taught at the U.S. Army Artillery Center and School at Ft. Sill, Oklahoma. On October 25, 1977, a meeting was held at Headquarters DARCOM to address the potential problem area. Representatives from DARCOM/BSI, the Field Artillery School, the Ballistic Research Laboratory, the Army Materiel Systems Analysis Agency (AMSAA), and The BDM Corporation were present at this meeting. During the meeting, the BDM preliminary and subsequent results using the U.S.A. Joint Munitions Effectiveness Manual solutions were presented and discussed. Following the meeting, the U.S.A. Joint Munitions Effectiveness Committee undertook a study to compare the two firing techniques and to determine the impact on the Battery Computer System (BCS) mechanization to take into account the effects of aiming from both the improved conventional munitions and the HE artillery rounds. The report of this committee is due to be issued in May of 1978. The classified BDM initial and subsequent results are contained in the classified annex to this unclassified report.

COMPARISON OF FIRING TECHNIQUES

PARALLEL SHEAF

ARTIFICIAL DISPERSION



PERSONNEL CASUALTY LEVELS

STANDING	30%
PRONE	22%
IN FOXHOLES	4%

12 BATTERY VOLLEYS

6 BATTERY VOLLEYS

B. CURRENT RPV/CLGP GENERAL EMPLOYMENT CONCEPT

The Remotely Piloted Vehicle (RPV) and the Cannon Launched Guided Projectile (CLGP) were developed as separate systems initially for separate missions. The RPV was to be primarily a reconnaissance and intelligence gathering system, and the CLGP was to be primarily an anti-armor system in Zone 1 using a ground laser locator designator (GLLD). Recent years have seen the Army attempt to use these two weapons systems together to attack armored targets both in Zone 1 and Zone 2 on the battlefield. The current RPV/CLGP employment concept envisions the RPV to be launched during daytime only, to search, locate, orbit and attack armored vehicles such as tanks, armored self-propelled artillery and armored personnel carriers. The primary objective of this RPV/CLGP attack mission is to kill all armored vehicles located. There are several problems with this concept.

(1) During the times when the RPV/CLGP combination will be the most critical, there will be more targets within CLGP range than can possibly be serviced by one RPV flight;

(2) The rapid movement of the vehicles primarily in Zone 2 will require tight command and control links between the RPV and the artillery firing the CLGP. Delays from the time the RPV locates the targets until the rounds arrive in the target area may result in the targets being beyond the maneuvering basket of the CLGP; and

(3) The orbiting technique used in designating the armored vehicle for CLGP attack, if superimposed upon Soviet air defense doctrine in Zone 2, will place the RPV in the maximum lethality envelope of the SA-9 and the ZSU-23-4 Warsaw Pact ground air defense systems, and the RPV only has to pass through this maximum attrition zone once to be lost, in all probability.

To continue on the current general employment philosophy, upon detecting the target the RPV operator commands the RPV to orbit the target and requests through TACFIRE the selection of a direct support battery to fire the CLGP mission on the target coordinates passed by the RPV operator. The TACFIRE system must then select the gun or guns to fire the mission, pass the mission information to the guns, and have the guns prepare to fire a CLGP mission.

CURRENT RPV / CLGP GENERAL EMPLOYMENT CONCEPT

- RPV LAUNCHED TO SEARCH (DAYTIME ONLY), LOCATE, ORBIT, AND ATTACK ARMORED VEHICLES (TANKS, ARTILLERY AND APCs)
- UPON DETECTING A TARGET, THE RPV OPERATOR COMMANDS THE RPV TO ORBIT THE TARGET AND REQUESTS TACFIRE TO SELECT A DIRECT SUPPORT BATTERY TO FIRE CLGP MISSION ON TARGET COORDINATES PASSED FROM RPV OPERATOR
- WHEN NOTIFIED BY TACFIRE OF THE APPROXIMATE TIME THAT ROUNDS SHOULD BE ARRIVING, THE RPV OPERATOR SETS THE RPV UP FOR PROPER DESIGNATION (NO MORE THAN 45^{0} FROM THE GUN TO TARGET LINE)
- RPV LASER DESIGNATOR OPERATED FROM 10 SECONDS TO 2 MINUTES CONTINUOUSLY DEPENDING ON NUMBER OF ROUNDS TO BE FIRED AT TARGET
- UPON VERIFICATION OF TARGET KILL START SEQUENCE OVER

It should be noted that it is a mission significantly different than the normal artillery missions the gun may be firing. For example, the CLGP round is substantially longer than the normal artillery rounds for the 155 mm howitzer, and therefore may not be with the gun and may not be readily available from storage. Further, the CLGP rounds, as currently planned to be dispersed among the units, will be of limited number with each gun, and therefore the unit may not have sufficient rounds to fire the mission.

When notified by TACFIRE that the gun or guns have been selected and the approximate time that the rounds should be arriving, the RPV operator sets the RPV up for proper designation. This set-up area is normally stated to be no greater than $\pm 45^{o}$ from the gun to target line. Just prior to the planned round arrival time, the RPV laser designator is turned on and is operated from 10 seconds to two minutes continuously, depending upon the number of rounds to be fired at the target in order to get a kill. Should the target be killed on the first, second or third round, the communication loop is sufficiently slow to be unable to let the guns know that the remaining rounds are firing at a dead target. This is not a very efficient or cost-effective way to handle the expensive CLGP artillery rounds.

Upon verification of target kill, through the RPV to the RPV ground control station operator to the TACFIRE to the guns, the firing sequence is stopped and the search sequence commences once more.

In summary, the current RPV/CLGP employment concept is too slow, requiring time lines that are not compatible with Soviet attack speeds in Zone 2. The RPV is planned to operate in a manner which will place it in maximum vulnerability to a highly lethal Soviet ground air defenses. The concept focuses on killing a single armored vehicle one at a time in an area in which there are tens, if not hundreds, of armored vehicles and the RPV only has two and one-half flight time at most to extract the maximum amount of delay, disorganization and destruction on those units.

C. BDM PROPOSED RPV/CLGP EMPLOYMENT CONCEPTS

In general, the BDM approach to reviewing the RPV/CLGP employment concepts has been to tailor the concepts around the enemy objectives and preferred attack options. These have been compared with the NATO combined arms defense alternatives to try and maximize the amount of delay, destruction and disorganization (D^3) compatible with the NATO direct fire defense alternatives.

For the purpose of this analysis, it is assumed that the Warsaw Pact armored vehicle densities in areas most consistent with their doctrine will be sufficient, during attack preparation (which normally occurs at night) and surge conditions (which normally occur during the day) to assign direct support platoons collocated with the Battery Computer System (BCS) to fire primarily CLGP missions. In this way, the CLGP rounds which are now planned to be distributed throughout the direct support artillery units can be assembeld with the platoons, which will be firing primarily those missions. Also, the command and control system, which is from the RPV ground control station directly to the platoon collocated with that BCS will provide the quick fire channel in order to minimize the times from the RPV location to the artillery attack.

The key question, then, is how to optimize the RPV/CLGP usage in concert with TAC AIR and based upon the likely threat tactics to increase the NATO ability to detect armored movement, and the Zone 1 direct fire kill zones. This optimization would attempt to extract the maximum delay, disorganization and destruction on the enemy before engagement by the NATO direct fire weapons. The importance of dealy and disorganization cannot be over-emphasized, because the Soviet attack plan has been optimized to apply armored surge conditions to the NATO defense forces such that breakthrough can occur prior to the end of the first combat day. Delay and disorganization can throw these surge conditions out of phase and allow our direct fire weapons and other assets to extract much higher attrition than the Soviets had planned to accept. This alone may spell defeat of the Soviet attack objective.

The concept is also focused on reducing the command, control and communication delays and mistakes by pre-planning the RPV/CLGP attack sequences to the maximum degree possible consistent with the concepts employed. In other words, the BDM concepts are trying to minimize the C^3 timelines from RPV detection to CLGP attack and minimize the chance for error in this sequence.

BDM

PROPOSED RPV / CLGP EMPLOYMENT CONCEPTS

- TAILOR CONCEPTS AROUND ENEMY OBJECTIVES / PREFERRED ATTACK OPTIONS AND NATO COMBINED ARMS DEFENSE ALTERNATIVES
- ASSUME THAT WARSAW PACT ARMORED VEHICLE DENSITIES IN AREAS MOST CONSISTENT WITH DOCTRINE WILL BE SUFFICIENT DURING ATTACK PREPARATION (NIGHT) AND SURGE (DAY) CONDITIONS TO ASSIGN DIRECT SUPPORT PLATOONS (COLLOCATED WITH BCS) TO FIRE PRIMARILY CLGP MISSIONS
- OPTIMIZE RPV / CLGP USAGE (IN CONCERT WITH TAC AIR) BASED UPON LIKELY THREAT TACTICS, ARMOR MOVEMENT SENSORS, AND ZONE 1 DIRECT FIRE KILL ZONES TO EXTRACT MAXIMUM DELAY, DISORGANIZATION AND DESTRUCTION (D^3) ON THE ENEMY BEFORE ENGAGEMENT BY NATO DIRECT FIRE WEAPONS
- REDUCE C^3 DELAYS OR MISTAKES BY PREPLANNING RPV / CLGP ATTACK SEQUENCES TO THE DEGREE POSSIBLE CONSISTENT WITH CONCEPTS EMPLOYED

D. BDM DETAILED RPV/CLGP EMPLOYMENT OPTIONS (COUNTER MISSIONS)

The RPV/CLGP employment options appear to be best characterized in terms of Warsaw Pact counter mission options. These counter missions are counter battery, counter armor, and counter air defense.

The counter battery mission is fundamentally based on the requirement to find and destroy the enemy armored self-propelled artillery before it can fire, and to suppress the enemy towed artillery either prior to or during its firing sequence. In order to accomplish this delay, disorganization and destruction of the armored self-propelled artillery on the road, normally at the head of the maneuver columns, using Road Runner RPV/CLGP tactics developed by BDM in this study, appear to be very attractive for the first counter battery mission. This tactic allows the targets to be attacked before they deploy to support the maneuver units.

Once the armored self-propelled artillery has deployed, then the RPV tactic most preferred would be to use the Race Track tactic for artillery operating in deflade beyond Zone 1. This tactic is tailored to searching out and finding the armored self-propelled artillery as the highest priority objective in a manner consistent with the fact that there are fewer air defense systems normally deployed with the artillery, and therefore the RPV has much more flexibility to operate when attacking the artillery in defilade. The other objective of the tactic is to suppress the towed artillery, using the highly accurate RPV target location scheme and subsequent attack by artillery delivered improved conventional munitions (ICM).

One of the highest priority and newest missions of the Soviet self-propelled armored artillery appears to be to use these systems in a direct fire role in support of the armored maneuver units. These artillery systems would operate at approximately 3-5 kilometers from the line of contact, and generally out of the anti-armor direct fire weapon range of the NATO forces. It is, therefore, important that these armored self-propelled artillery pieces attempting to suppress the NATO direct fire units be destroyed using either a ground launched laser designator or an airborne RPV with a designator. The airborne RPV designator appears to be the best solution because of the range at which the targets appear (3-5 kilometers). In addition, the RPV is not nearly as susceptible to masking by smoke, as is the ground laser locator designator, if the enemy chooses to lay smoke on the NATO direct fire positions.

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DETAILED RPV / CLGP EMPLOYMENT OPTIONS

(COUNTER MISSIONS)

- COUNTERBATTERY MISSION - FIND (AND DESTROY) BEFORE FIRE
  - D^3 ARMORED, SELF-PROPELLED (A-SP) ARTILLERY ON ROAD (AT THE HEAD OF A COLUMN) USING "ROAD RUNNER" RPV / CLGP TACTICS BEFORE TARGET DEPLOYMENT FOR MANEUVER UNIT SUPPORT
  - KILL A-SP ARTILLERY AFTER DEPLOYMENT USING "RACE TRACK" RPV / CLGP TACTICS. SUPPRESS TOWED ARTILLERY USING HIGHLY ACCURATE RPV TARGET LOCATION FOR SUBSEQUENT ATTACK BY ICM
  - TREAT A-SP ARTILLERY BEING USED IN DIRECT FIRE ROLE AS HIGHER PRIORITY RPV / CLGP TARGETS THAN TANKS IN THE 3 - 5 KM REGION OF ZONE 1

The second RPV/CLGP counter mission is the counter armor mission. The objective of this mission is to control the armor presentation rate into Zone 1, and to prevent disclosure of the defense force weaknesses. The delay, disorganization and destruction (D^3) of the armored convoys moving on the road mainly in Zone 2A is critical to controlling the presentation rate of these systems into Zone 1, where they can engage our direct fire weapons. Further, these units normally move in the Soviet interpretation of nuclear safe combat posture, i.e., approximately one kilometer separating companies moving on the road. The best employment of the RPV in this instance is to utilize the Road Runner concept pre-planned similar to and contiguous with the Zone 1 direct fire kill zones which have also been pre-planned. The pre-planning would be to choose the platoon of guns to operate with the particular RPV, to pre-plan the rate at which the CLGPs would be fired along the road, and fire one round per gun per minute allowing for minor adjustments for the RPV movement along the road between rounds being fired.

The second important counter armor mission is to deny the disclosure of the NATO defense weaknesses by attacking and killing the Warsaw Pact reconnaissance forces using RPVs and CLGPs both in Zone 1 and Zone 2 but with the major emphasis on the killing in Zone 1. The concept here is to prevent the Soviets from achieving their reconnaissance objectives which are to find the weaknesses in the NATO direct fire defense so that the main body moving behind the reconnaissance forces can attack the weak links, and as a result absorb the minimum amount of casualties while they breakthrough the defense to go deep. If the CLGP were used with the ground laser locator designator, the defensive positions would be given away to a certain degree because the ground laser locator designators are employed in the Zone 1 defense array.

The counter air defense mission has an objective to provide a benign environment for the attack helicopters and fixed wing TAC AIR to operate primarily against Zone 1. These two attack systems when operating in a benign environment have extremely high loss exchange ratios and provide excellent complementary attack forces to the ground based direct fire weapons. Therefore, the objective is to kill the mobile air defenses traveling with the armored columns as part of the Road Runner and Race Track concepts employed in Zone 2. Upon arrival of the units in Zone 1 the RPV then would provide its own self-protection by attacking the air defenses in Zone 1 and improve or develop the benign environment for the attack helicopters and TAC AIR to be brought to bear on the units should the NATO ground defense require such assistance.

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DETAILED RPV / CLGP EMPLOYMENT OPTIONS (CONT.)

(COUNTER MISSIONS)

- COUNTER ARMOR MISSION - CONTROL ARMOR PRESENTATION RATE INTO ZONE 1 AND PREVENT DISCLOSURE OF DEFENSE FORCE WEAKNESSES
  - D^3 ARMOR CONVOYS MOVING (MAINLY IN ZONE 2A) IN OR NEAR NUCLEAR SAFE POSTURE UTILIZING "ROAD RUNNER" CONCEPTS PREPLANNED SIMILAR TO AND CONTIGUOUS WITH ZONE 1 DIRECT FIRE KILL ZONES
  - DENY DISCLOSURE OF NATO DEFENSE WEAKNESSES BY KILLING WARSAW PACT RECCE FORCES USING RPV / CLGP IN ZONE 1
- COUNTER AIR DEFENSE - PROVIDE BENIGN ENVIRONMENT FOR ATTACK HELOS AND TAC AIR TO OPERATE PRIMARILY IN ZONE 1
  - KILL MOBILE AIR DEFENSES TRAVELING WITH ARMOR COLUMNS AS PART OF "ROAD RUNNER" AND "RACE TRACK" CONCEPTS
  - PROVIDE RPV SELF-PROTECTION IN ZONE 1

CHAPTER II

ZONE I TARGET ACQUISITION IDENTIFICATION AND DESIGNATION FOR CANNON LAUNCHED GUIDED PROJECTILES

CHAPTER II

ZONE I TARGET ACQUISITION IDENTIFICATION AND DESIGNATION FOR CANNON LAUNCHED GUIDED PROJECTILES

A. OVERVIEW FOR ZONE I

Early in the study effort the review of changes to the Field Artillery Cannon Gunnery Manual (FM6-40) which included procedures for the tactical/technical employment of the CLGP/GVLLD Systems indicated that a FIST team would be organic to each maneuver company instead of each battalion as previously thought. These changes occurred in February and July of 1977. Using this employment concept where a GVLLD equipped FIST team was deployed with every maneuver company, the possibility of significant Zone I gaps in laser locator designator coverage was significantly reduced. Therefore, the study research effort concentrated on the use of the cannon launched guided projectile as designated by the remotely piloted vehicle and the counter missions best suited for Zone I. These missions were:

(1) Counter Battery: to attack the armored self-propelled artillery supporting Zone I maneuver units approximately 3 to 5 kilometers behind the line of contact (maneuver battle);

(2) Counter Air Defense: to clear Zone I for NATO air attack against the main body (maneuver battle and breakthrough); and

(3) Counter Armor: (a) to prevent disclosure of the direct fire position vulnerabilities by RPV/CLGP attack of reconnaissance units (maneuver battle), (b) to designate from the RPV when the direct fire units are being suppressed by enemy delivered smoke (maneuver battle and breakthrough) and (c) to assist in the Zone I active defense of direct fire forces (breakthrough).

For each of these counter mission objectives, it was determined that the RPV being used as a designator was more beneficial than either the use of additional ground/vehicular laser locator designators or airborne laser locator designators used in the scout helicopters.

RPV/CLGP MISSION	WP TACTIC	
	MANEUVER BATTLE	BREAKTHROUGH
COUNTER BATTERY	1. ROAD RUNNER IN ZONE 2 2. 3-5 KM ZONE 1 ATTACK OF ARMORED, SELF-PROPELLED ARTILLERY ATTACHED TO MANEUVER UNITS 3. RACE TRACK IN ZONE 2	1. ROAD RUNNER IN ZONE 2 2. RACE TRACK (KILL BEFORE FIRE) IN ZONE 2
COUNTER ARMOR	1. ROAD RUNNER IN ZONE 2 2. SUPPLEMENT DIRECT FIRE DEFENSE IN ZONE 1 a. DELAY RECOGNITION b. DESIGNATE OVER TOP OF SMOKE	1. ROAD RUNNER IN ZONE 2 2. ASSIST IN ACTIVE DEFENSE IN ZONE 1 3. DESIGNATE OVER TOP OF SMOKE
COUNTER AIR DEFENSE	1. ROAD RUNNER IN ZONE 2 2. CLEAR ZONE 1 FOR NATO AIR ATTACK AGAINST MAIN BODY	1. ROAD RUNNER IN ZONE 2 2. CLEAR ZONE 1 FOR NATO AIR ATTACK AGAINST MAIN BODY

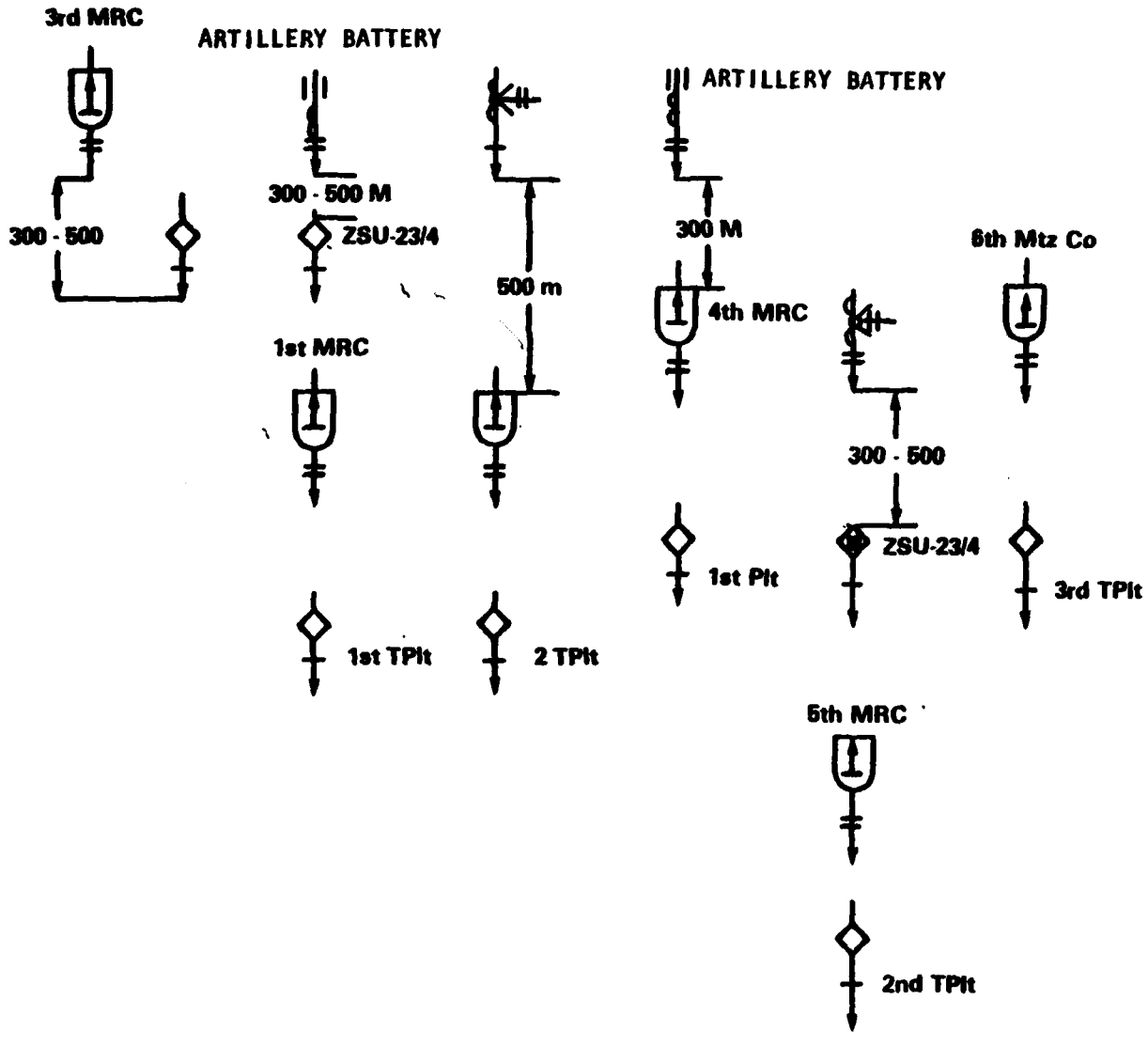
RPV/CLGP MISISONS VS. WP TACTICS

B. COUNTERBATTERY MISSION

The Soviet emphasis on nuclear warfare at all combat levels in the late 1950s and early 1960s plus Premier Khrushchev's desire to hold down conventional or non-nuclear military spending spelled the end of the Soviet self-propelled artillery development until the early 1970s. In 1973, the Soviets introduced the 152mm armored self-propelled artillery piece (M-1973). The fully enclosed turret of this new artillery piece could rotate 360° and appeared to have chemical, biological and nuclear radiation protection lining. The gun itself was placed on a modified SA-4 (GANEF) transporter. In 1974, the Soviets introduced a 122mm self-propelled, armored gun also with a fully enclosed gun turret which could rotate 360°. The M1974 122mm gun was mounted on a modified PT-76 light tank chassis and therefore was believed to possess a potential swimming capability. The primary mission of the new armored self-propelled artillery pieces appear to provide highly mobile firing power to be used both in indirect and direct fire roles depending upon the type of attack. As early as June 1975 in an issue of Military Herald, LTG of Artillery B. Koritchuk declared "As we see it, combating the anti-tank systems of the enemy has become one of the most important missions of the artillery". The M1974 is particularly suited for this type of mission.

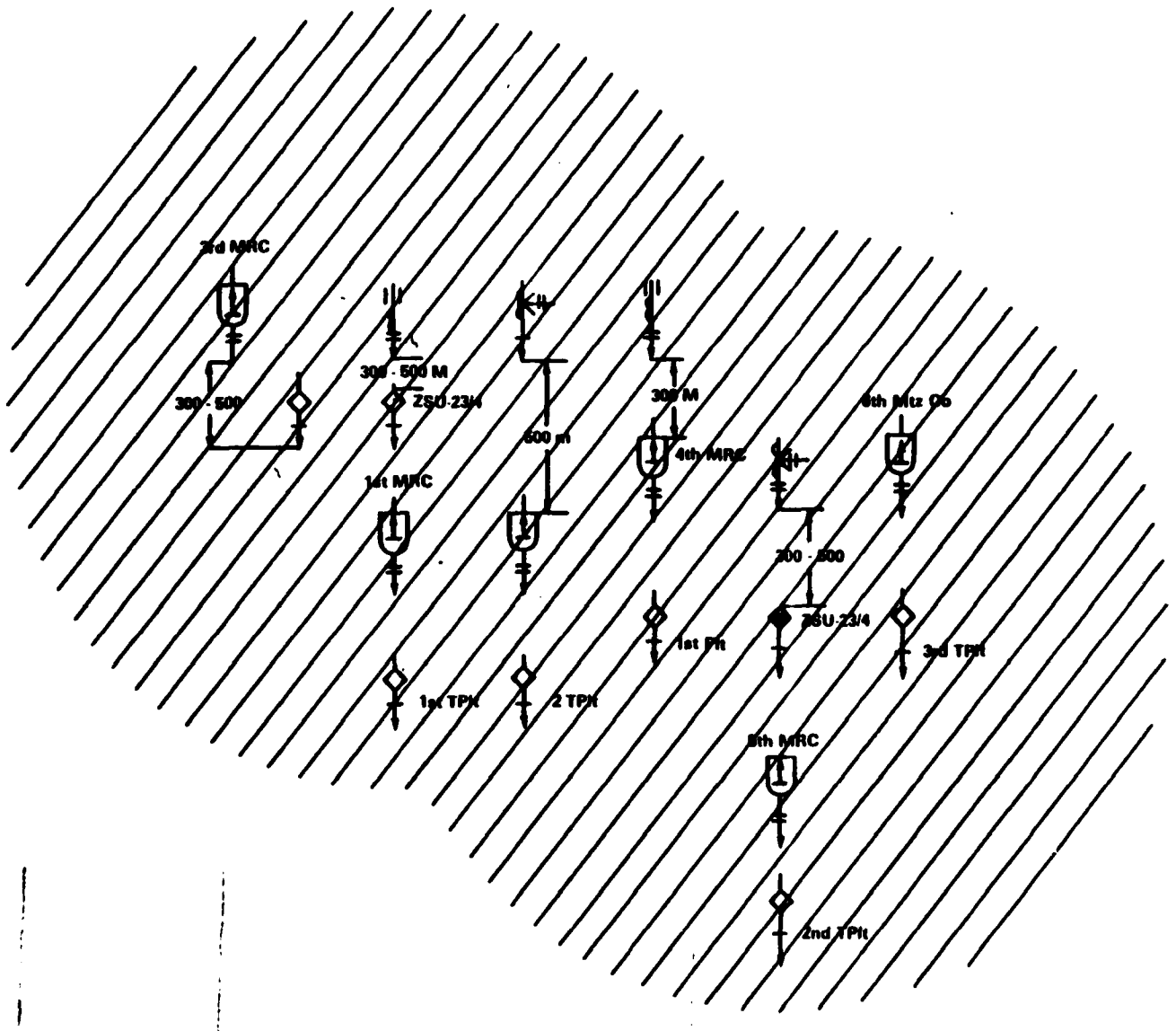
Further, in the Military Herald edition of May 1977 entitled "On the Actions of Batteries of Self-Propelled Howitzers", Col. Marakhovski stated that in several circumstances self-propelled howitzers may be used for direct fire to augment tanks and anti-tank means. Control of fire by direct lay, in this case, should be done by platoons since the weapons will be found at intervals of 100-200 meters or greater. The fire of one platoon is directed by the commander of the battery, the other by the senior officer of the battery. It was further seen in another Military Herald article that the artillery would be at approximately 3 to 5 kilometers from the line of contact behind the tanks, armored fighting vehicles and air defenses providing semi-direct assistance to suppress the anti-tank systems operating on the cutting edge of the attacking force. In this way the relatively lightly armored self-propelled artillery could provide the Zone I protection because they would be outside the range of the anti-tank means. The light armor and basic design of the Soviet self-propelled artillery systems appear to possess a mobility matched to the Soviet T-72 tank and the BMP. This is true not only for the armored self-propelled artillery guns but also for the artillery command vehicles and the artillery resupply vehicles. All appear to be designed as a single artillery support unit.

ATTACK FORMATION



C. COUNTER AIR DEFENSE MISSION

As with the discussion on the use of artillery in support of Zone I operations, the Soviets write extensively about the use of intense air defense over the attacking units. This air defense is desinged to provide an environment in which attacking enemy aircraft pay a substantial price for any Warsaw Pact combined arms losses that they may obtain. As shown in the Figure, the air defense units normally are placed behind the leading tanks and motorized rifle units but slightly in front of the supporting armored self-propelled artillery. This is approximately 2 to 4 kilometers beyond the line of contact and marginally in range of the TOW anti-tank missile system and the CLGP ground laser locator designator. In addition, these air defenses may attempt to use terrain masking from the NATO direct fire weapons. A more pragmatic reason for considering the use of the RPV/CLGP combination for the attack for the Zone I air defense is the fact that the ground laser locator designator must look behind the tanks and APCs that are bearing down on his position before he ever gets to the air defenses. As a result he probably will have his hands full with simply attacking the direct fire armor systems. On the other hand, since the RPV survivability is directly related to its ability to suppress the enemy air defense, this is a logical mission for the RPV/CLGP combination.


2nd MRC
300 - 500
300 - 500 M
ZSU-23/4
14t MRC
1st TPlt
2 TPlt
600 m
4th MRC
300 M
1st Plt
8th Mtz Co
200 - 500
ZSU-23/4
3rd TPlt
5th MRC
2nd TPlt

D. COUNTER ARMOR MISSION

The counter armor mission in Zone I manifests itself in three different areas. The first, and the one least understood initially, is the mission to prevent the successful accomplishment of the Soviet reconnaissance force objectives in the maneuver battle. The second counter armor mission area is to delay, disorganize and destroy Zone I armored targets if the NATO direct fire defense force is being suppressed by artillery delivering smoke. The third mission is to play a major role in the anti-armor attack while the NATO forces are repositioning for better defense (the active defense concept). For the purpose of this discussion, the maneuver battle is characterized by motorize rifle regiments operating in the meeting engagement. It can be seen that the enemy build up of force is rather slow, requiring some 2 to 3 hours for the main body to be committed. For example, following an initial probe by up to three BMPs, the Warsaw Pact would commit a second force (the advanced party) consisting of ten BMPs, four tanks and six howitzers. Within one hour, the advanced guard can be expected to be engaged. The size of the target array is some 31 BMPs, 13 tanks and 18 armored self-propelled howitzers for a total array of 62 armored vehicles. Finally, at about 2 to 3 hours after the initial contact was made, the full main body is committed to the operation. The main body target array consists of a total of 169 armored vehicles.

It is therefore important to deny the successful accomplishment of the Soviet objectives of each of the groups and armored vehicles in the maneuver battle build up. The time lines for the initial contact is some 20 to 30 minutes in which the Warsaw Pact, with its three BMPs, attempts to conduct initial reconnaissance of the enemy location. The NATO counter objective therefore should be to not reveal the direct fire disposition by allowing the RPV/CLGP combination to kill all three BMPs before they close on the direct fire positions. In the second array, the time available is some 30 to 40 minutes in which the Warsaw Pact advanced party attempts to fix and engage the NATO defense. The NATO objective therefore should be to inhibit definition of the defense dispositon. To achieve this counter objective, the RPV/CLGP combination should achieve at least Soviet annihilation criteria on the armored vehicles. In other words, to kill some 7 to 9 vehicles (or 50 to 60%) of the total in the array.

BUILDUP OF FIREPOWER — **MOTORIZED RIFLE REGIMENT IN THE MEETING ENGAGEMENT**

ELAPSED TIME	STAGE OF ACTION	Red Forces Committed (Cumulative)								
		BMP'S	TANKS	HOWITZERS (122 mm)	MORTARS (120 mm)	ANTITANK SAGGER (GROUND MOUNT)	ANTITANK SAGGER (BRDM MOUNT)	ANTITANK (SPG-9 RECOILLESS RIFLE)	ANTIAIRCRAFT (ZSU 23/4 QUAD 23 mm)	ANTIAIRCRAFT (SA 9 SURFACE TO AIR MISSILE
0	Initial Contact (Combat Recon. Patrol)	3								
20-30 Minutes	Advance Party Engaged	10	4	0	0	2		2		
1 Hour	Advanced Guard Main Force Engaged	31	13	18	0	2	3	3	3	
2-3 Hours	Regimental Main Force Committed	93	40	36	18	0	0	0	4	4

22

WARSAW PACT FORCES BELIEVE THAT AT LEAST SIXTY PERCENT (60%) OF THE LEAD ECHELON REGIMENT OPERATIONS WILL BE ROAD MARCH OF COMBAT POWER AS SHOWN ABOVE WITH THE REMAINING FORTY PERCENT (40%) ALLOCATED BETWEEN MEETING ENGAGEMENTS, ATTACK FROM THE MARCH (TACTICAL BREAKTHROUGH) AND OPERATIONAL (CLASSICAL) BREAKTHROUGHS IN DESCENDING ORDER OF PREFERENCE.

The advanced guard of the main body has as its objective to probe the defense and to determine the weaknesses of the defense so that the main body may focus its attack on these weaknesses. It is therefore the objective of NATO to reduce the attackers' combat power and thus prevent the enemy's definition of direct fire weaknesses. In order to accomplish this, it should be the RPV/CLGP requirement to neutralize the enemy maneuver units by killing some 11 to 14 vehicles evenly dispersed among the combat units. These armored vehicle losses represent Soviet neutralization criteria of 20 to 30%. This will delay, according to Soviet norms, the assault on the direct line fire positions and thus delay commitment of the main body. If all the aforementioned artillery RPV/CLGP missions are successful in Zone 1, then the enemy is faced with the dilemma of either committing his main body blind without knowing the NATO weaknesses or possibly not committing the main body at all. If he decides to commit the main body he has then two choices: (a) to attempt to conduct a breakthrough at the regimental level, or (b) to commit his force evenly across the attack sector (which would be approximately 5 kilometers wide). In each instance the attack would be favorable to NATO. Should the enemy decide to attack, the Zone 1 RPV/CLGP objectives then would be to harass and disorganize the direct fire units of the enemy and to annihilate the air defense units. To accomplish these objectives would require the destruction of some 17 to 25 selected vehicles. The key objective in the prevention of the main body attack for the RPV/CLGP combination would be to degrade the enemy Zone 1 air defense to allow the NATO air support (both fixed and rotary) wing to operate in Zone 1 in a relatively benign enemy air defense environment. This would allow the overall loss exchange ratio to be significantly increased.

In order to accomplish the NATO artillery Zone 1 objective by use of the RPV/CLGP combination, it was important to conduct the analysis at a high confidence level of mission accomplishment. The confidence level chosen was 80% since it appeared that this was the best trade-off between rounds expended and likelihood of mission accomplishment. It was further determined necessary to test the sensitivity of the CLGP's single shot probability of kill (Pkss) in determining the overall likelihood of mission accomplishment. The numbers chosen were 0.33 and 0.10. Results were then calculated for each of the target Pkss values using two types of tactics. The first tactic was described as the shoot-look-shoot tactic and the second was to shoot five CLGPs without the shoot-look-shoot tactics. The shoot-look-shoot were chosen because of the requirement to achieve a total or a large percentage kill with a high confidence of a rather small number of vehicles in the initial target arrays. As the number of vehicles in the targets set went up and the requirement for destruction percentage went down in the latter arrays, the requirement for shoot-look-shoot tactics was lessened considerably. The final consideration for the attack of the first three target arrays was that each gun was allowed to fire one round every two minutes because of the relatively short time lines compared to the attack of the main body. For the main body attack each gun was allowed to fire only every three minutes.

ZONE 1

TIMELINE FOR PREVENTION OF WARSAW PACT ATTACK SUCCESS AND ARTILLERY OPPORTUNITIES

ELAPSED TIME	STAGE OF ACTION	WARSAW PACT OBJECTIVE	NATO OBJECTIVE	ZONE 1 OPPORTUNITY FOR ARTILLERY
0-20 MINUTES	INITIAL CONTACT	INITIAL RECONNAISSANCE OF ENEMY LOCATION	DO NOT REVEAL DIRECT FIRE DISPOSITION	KILL ALL THREE (3) BMPs BEFORE THEY CLOSE ON DIRECT FIRE POSITIONS
20-30 MINUTES	ADVANCED PARTY ENGAGED	FIX AND ENGAGE ENEMY POSITIONS	INHIBIT DEFINITION OF DEFENSIVE DISPOSITION	ACHIEVE SOVIET ANNIHILATION CRITERIA ON ARMORED VEHICLES (KILL 7-9)
1 HOUR	ADVANCED GUARD MAIN FORCE ENGAGED	PROBE DEFENSE AND DETERMINE WEAKNESSES FOR MAIN BODY ATTACK FOCUS	REDUCE ATTACKER COMBAT POWER TO PREVENT HIS DEFINITION OF YOUR WEAKNESSES	NEUTRALIZE ENEMY MANEUVER UNITS (KILL 11-14 VEHICLES EVENLY DISPERSED AMONG COMBAT UNITS) TO DELAY ASSAULT OF DIRECT FIRE POSITIONS
2-3 HOURS	REGIMENTAL MAIN FORCE COMMITTED	FOCUS MAIN BODY ON DEFENSE WEAKNESS, BREAKTHROUGH (b) AND EXPLOIT SUCCESS BY GOING DEEP (20-30 KM)	PREVENT COMMITMENT OF MAIN BODY OR CONFUSE COMMITMENT SUFFICIENTLY TO PREVENT BREECHING OF DEFENSIVE POSITIONS	HARASS AND DISORGANIZE DIRECT FIRE UNITS, AND ANNIHILATE AIR DEFENSE UNITS (KILL 17-25 SELECTED VEHICLES) TO ENHANCE GROUND AND AIR DIRECT FIRE EXCHANGE RATIOS

The results of the research approach indicated that if the single shot probability to kill was 0.33 and the tactics described were used then a platoon of two guns firing CLGP at rates of one round every two minutes for the first three sets followed by one round every three minutes for the last target set would be sufficient to accomplish with a high degree of confidence the objective laid out for the RPV/CLGP mission. If on the other hand the Pkss was 0.10 then approximately a battery of guns would be required to deliver the rounds to achieve the objectives. In either case, the platoon or battery of dedicated guns during this surge condition did appear to achieve a significant artillery result which had not previously been anticipated for this type of combat.

WARSAW PACT ATTACK FROM THE MARCH
TIMELINE FOR EXPENDITURE OF COPPERHEAD
ROUNDS TO ACHIEVE NATO OBJECTIVES
WITH 80% CONFIDENCE

ATTACK DURATION	STAGE OF ACTION	KILLS REQUIRED	NUMBER OF COPPERHEAD ROUNDS P_{kss} = 0.33	NUMBER OF COPPERHEAD ROUNDS P_{kss} = 0.10	NUMBER OF DEDICATED ARTILLERY TUBES* .33	NUMBER OF DEDICATED ARTILLERY TUBES* .10
10-20 MINUTES	INITIAL CONTACT	3 BMPs	12[1] 20[2]	42[1] 75[2]	1-2[1] 2-4[2]	5-9[1] 8-15[2]
30-50 MINUTES	ADVANCED PARTY ENGAGED	7-9 ARMORED VEHICLES	26-33 30-43	92-116 114-164	1-3 2-3	4-8 5-11
50-150 MINUTES	ADVANCED GUARD MAIN FORCE ENGAGED	11-14 ARMORED VEHICLES EVENLY DISPERSED AMONG COMBAT UNITS	39-49 39-51	144-183 148-193	1-2 1-2	2-8 2-8
330-480 MINUTES	REGIMENTAL MAIN FORCE COMMITTED	17-25 SELECTED ARMORED VEHICLES	65 70	236 296	1** 1**	2-3** 2-3**

[1] WITH SHOOT-LOOK-SHOOT TACTICS

[2] WITHOUT SHOOT-LOOK-SHOOT TACTICS

* EACH GUN FIRING ONE ROUND EVERY TWO MINUTES

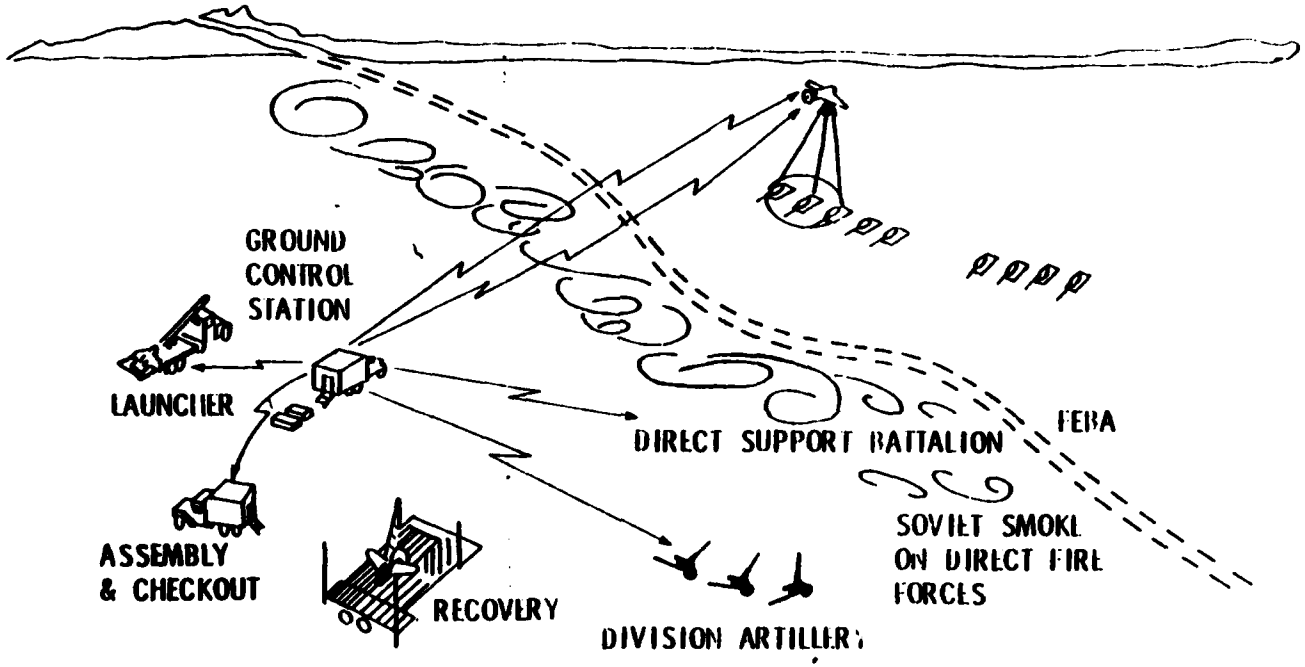
** EACH GUN FIRING ONE ROUND EVERY THREE MINUTES

The final counter armor missions were missions in support of the direct fire forces if they were being smoked by the enemy's artillery and when they were conducting an active defense. In both instances the RPV/CLGP combination will play a critical role in Zone I in delaying, disorganizing and destroying the armored vehicles in that Zone.

It is important to understand that the delivery of smoke on the NATO direct fire positions and the active defense may be interrelated. For example, the Red delivery of smoke on a direct fire defense may require those defenses to be repositioned so that they may be able to defend more effectively. Secondly, in the active defense, when the direct fire units want to reposition themselves for more favorable kill zones the use of smoke by NATO artillery may assist in enhancing the survivability of the direct fire force movement. In both cases, the RPV/CLGP combination with the mission of delay, disorganization and limited destruction from the time when it was available could play a critical role in delaying the enemy's closure on the new NATO direct fire positions until NATO was ready to optimally attack the enemy forces at favorable ranges.

ZONE 1

OPERATIONAL SYSTEM



E. RPV/CLGP/COMPONENTS/FUNCTION

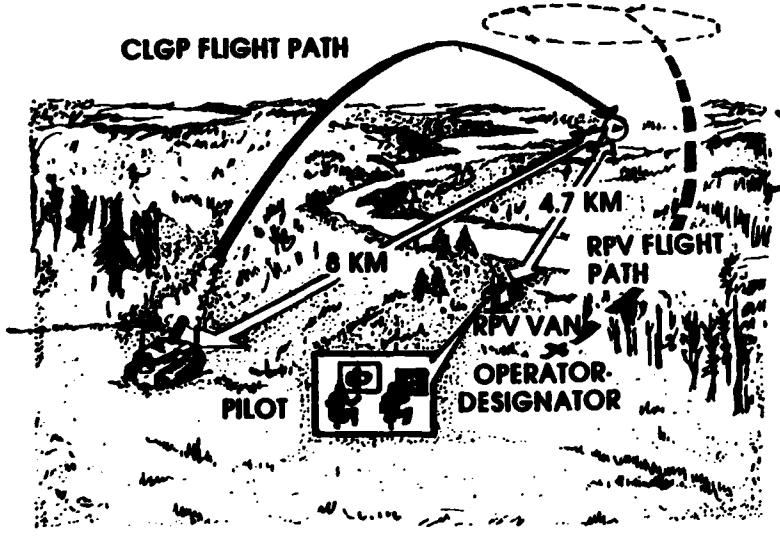
The critical components and functions of the RPV/CLGP combination are the M-712 cannon launched guided projectile (CLGP) fired from either the M109A1 armored self-propelled 155mm howitzer or the helicopter transportable M198 towed howitzer. During flight, the enemy target is designated by a laser designator and the seeker in the nose of the M712 detects the semi-active laser signature and uses a signal to operate the control surfaces to direct the round on a collision course with the target. The kill mechanism is a shaped charge warhead. The laser designators will be coded and the grounds properly prepared such that the round will only track the laser designation with the proper coded signature. The M-712 CLGP is currently programmed to NATO standardization.

The XMQM-105 AQUILA is currently under development by the U.S. Army. The key components in the RPV system are the RPV with its launch and recovery sub-systems and the ground control station with its pilot operator/designator. For Zone I operations, the ground control station would be approximately 5 km from the target area and control the RPV flying approximately 1000 feet altitude over the target area. The howitzer that launches the CLGP should be in close proximity to the RPV ground control station. However, it could be as far away for the Zone I attack problem as 8 kilometers.

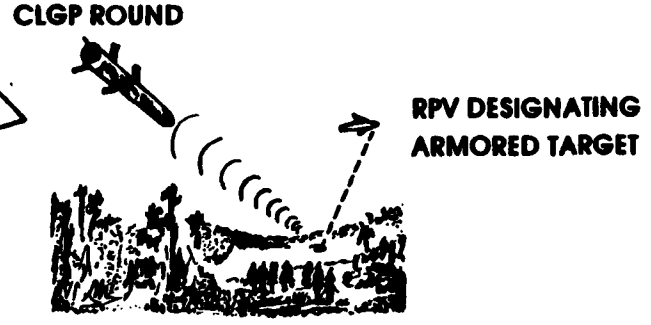
During the attack sequence, the RPV would designate with its laser locator designator the armored target with a laser code compatible with the incoming cannon launched guided projectile round. The length of designation time will be closely related to the amount of coordination between the RPV ground control station and the CLGP howitzer launch platform. This coordination should include a signficant amount of pre-planning to prevent excessive laser designator run time per target attack, and the possibility of improper operation.

RPV/CLGP
COMPONENTS/FUNCTIONS
(ZONE 1 CASE)

COMPONENT RELATIONSHIP



ATTACK SEQUENCE



CHAPTER III

ZONE 2 TARGET ACQUISITION AND DESIGNATION FOR CANNON LAUNCHED GUIDED PROJECTILES

CHAPTER III

ZONE 2 TARGET ACQUISITION AND DESIGNATION FOR CANNON LAUNCHED GUIDED PROJECTILES

A. BACKGROUND

The Fire Support Mission Area Study, conducted for DARCOM/BSI between September 1976 and March 1977, has indicated that a critical factor in reducing the overall threat target presentation rate in Zone 1 (line-of-sight) is the attack of the armored threat systems in Zone 2 to inflict delay, disruption and limited destruction on these systems prior to their entrance into Zone 1. To accomplish this, improved efficiency in the use of U.S. artillery will require the integration of the Stand-Off Target Acquisition System (SOTAS), the Forward Observer Remotely Piloted Vehicle (FO RPV) and the Cannon Launched Guided Projectile (CLGP). In addition, the improved automated fire support resource allocation system or TACFIRE/BCS will allow for better and faster integration of the target acquisition and attack components. This Zone 2 attack capability is particularly important when the threat doctrine, tactics, organization and hardware capability are coupled with the new NATO heavy forward defense, lateral movement on the battlefield, and emerging target acquisition capability by providing an ability to attack the enemy in depth, thus reducing the Soviet chances of puncturing the U.S. heavy forward defense before the NATO reserves can move laterally to reinforce.

FM 100-5 has defined regions or zones of the battlefield: Zone 1, the "Captains' Area" reaches from the FEBA to the ground line of sight limit (about 5 KM), and Zone 2, the "Colonels' Area" reaches out to 50 KM and is described as "the zone of indirect fire weapons, counterfire and tactical maneuver." This report addresses the ground line of sight limit to the limit of cannon artillery range 25-30 KM from the FEBA. This forward half of Zone 2 has been referred to as Zone 2A.

BACKGROUND

THE FIRE SUPPORT MISSION AREA STUDY (SEPTEMBER 1976 - MARCH 1977) CONDUCTED BY BDM FOR DARCOM/BSI INDICATED BASED UPON THREAT DOCTRINE, TACTICS, ORGANIZATION, AND HARDWARE CAPABILITY WHEN COUPLED WITH THE NEW NATO "HEAVY FORWARD" DEFENSE, LATERAL MOVEMENT AND EMERGING TARGET ACQUISITION CAPABILITY THAT ARTILLERY EMPHASIS WILL BE SHIFTING FROM ZONE I (LINE-OF-SIGHT) TO ZONE 2. KEY COMPONENTS OF THIS SHIFT WILL BE SOTAS, FO RPV (WITH VLLD), TAC FIRE/BCS, CLGP, DP ICM, FASCAM AND GSRS.

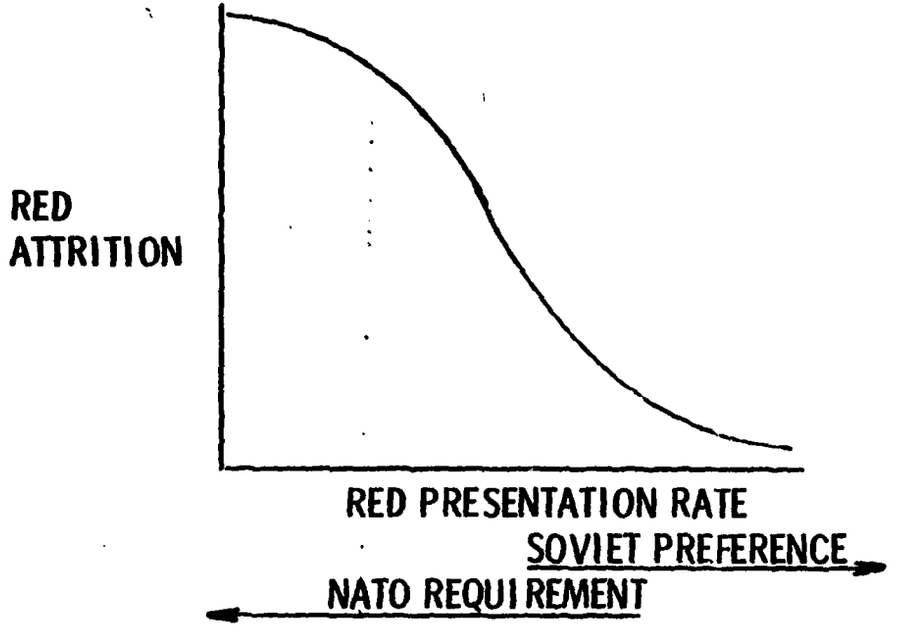
The Soviet formula for victory is based upon the generation of momentum, and momentum is defined as mass times velocity. In the past, much of the U.S. Army weapon development criteria and the tactics for employment of these weapons have been based upon the attrition of the threat mass. However, it is equally important to slow the velocity and, as a result, reduce the overall momentum. This research effort shows the importance of forcing the enemy to accept the attrition and maintain his velocity, or to reduce his velocity while taking lesser attrition. In this second case (velocity degradation), there are further fire support targeting benefits because the enemy would be forced off roads. Movement off roads would provide an ideal target for the Family of Scatterable Mines (FASCAM) delivered initialy by the M109A1 and eventually by the General Support Rocket System. (GSRS). In addition, cross country movements in Zone 2, reducing the forward velocity by approximately one half are not normally part of the attack time table and thus may well force the Soviet command and control system to heat up, providing additional fire support targets. Either process of reducing Soviet momentum is a satisfactory solution for NATO forces.

The Soviets also organize their combat velocity and echelonment criteria around the simple premise, shown on the opposite figure: the overall Red attrition is inversely proportional to presentation rate during key battles. In other words, if the Soviets can present their weapons at a very high rate in Zone 1, they contend from extensive review of World War II data that the overall attrition will be less because they will overwhelm the NATO defenses permitting a breakthrough and a resultant low casualty exploitation phase. It is the NATO requirement, therefore, to lower the presentation rate in Zone 1, while the Soviets are attempting to up the presentation rate through improved vehicle design, training, and force design.

SOVIET FORMULA FOR VICTORY

MOMENTUM = MASS X VELOCITY

SOVIET VIEW OF COMBAT VELOCITY AND ECHELONMENT



The Soviets are currently organized to attack in at least two ways: the classical breakthrough and the daring thrust. In the classical breakthrough case, the Soviets attempt to focus at least a division's worth of assets on a very small front, approximately four to seven kilometers in width. The Soviets are trained and organized to perform this type of attack if the enemy has presented a sufficiently strong linear defense to require massing to force an opening. The Soviets will concentrate 50 or more batteries of artillery to support the massive breakthrough attempt. Overall control of this operation will be at the division level assisted by the Army because Army and Front level assets will probably be attached. A second echelon division will also be committed for the exploitation of the breakthrough should the breakthrough sector open to a width of approximately 15 kilometers.

The daring thrust resurfaced as an important form of Soviet combat following the October 1973 war in the Middle East. The Soviets were much impressed with the high loss rates on the modern battlefield when the enemy is allowed to form a linear defense line. Therefore, through the daring thrust concept the Soviets are attempting to catch the defense in a granular configuration with holes that can be exploited without major commitment of forces in a frontal assault. The primary form of engagement in the daring thrust is the meeting engagement in which a small force (the advance guard) of approximately the same size as the defender attacks and fixes the defender while the main body exploits the vulnerabilities that the advanced guard have discovered in the defenses. To do this, the Soviets must maneuver on multiple axes and probably move off main roads in the final main body assault. The level of combat commitment to the daring thrust is usually in the order of a regimental sized unit. A regiment is eventually assigned to fix the Blue force, while other regiments try to bypass the heavy forward defenses and strike deep, focusing force on the weaker reserve units and moving on beyond the reserve, if possible. This type of an attack was carried out successfully in the 1945 Soviet Far Eastern campaign against the Japanese Army. It was further refined in the early 1960s, when the Soviets under Premier Kruschchev emphasized that all modern wars would be nuclear in nature, and thus there would be many gaps blown open in the defenses by nuclear weapons. The combination of speed and deception as practiced currently by the Soviets would indicate that a similar type attack maneuver could be conducted in a conventional conflict as well.

These two forms of attack provide the scenarios in which to assess the potential for use of SOTAS, FO RPVs, and CLGP in Zone 2. The value of such an integrated scheme to attack Zone 2 targets is assessed by examining the ability of the artillery to extract significant attrition and/or velocity degradation to the enemy units moving through Zone 2.

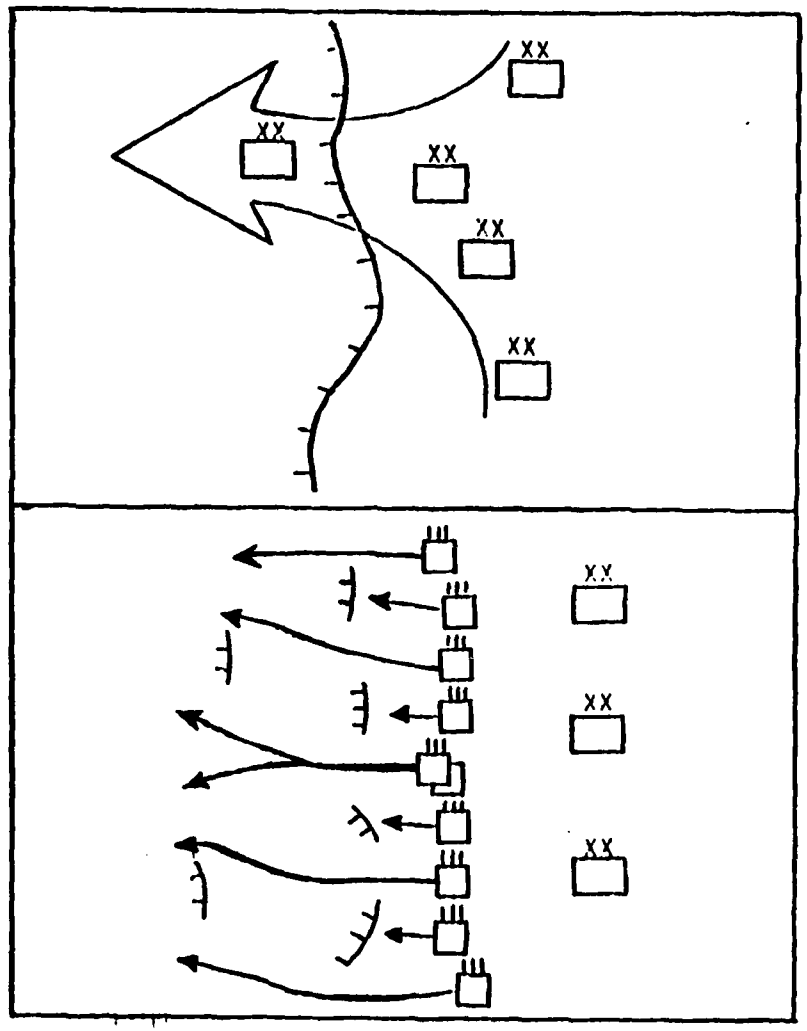
NEW EMPHASIS ON PRE-EMPTIVE MANEUVER

CLASSIC BREAKTHROUGH

- LINEAR DEFENSE
- MASS FOR ATTACK
- CONCENTRATED FIREPOWER
- DIVISION/ARMY LEVEL

"DARING THRUSTS"

- GRANULAR DEFENSE
- MEETING ENGAGEMENT
- MANEUVER ON MULTIPLE AXES
- REGIMENTAL LEVEL



B. OBJECTIVE

The objective of this research effort is to quantify the effectiveness of SOTAS, FO RPVs and CLGPs in reducing the presentation rate to Zone 1 through disruption, disorganization and destruction of armed forces in Zone 2. By definition, the armored forces include: tanks, armored personnel carriers, air defense systems and self-propelled armored artillery. The research will look beyond simply determining the capabilities of each of these new Army hardware systems and determine the integration and coordination required within the proposed organizational concepts of these systems to successfully attack the key targets in Zone 2. For purposes of this analysis, only that portion of Zone 2A from 3-5 to 25-30 kilometers beyond the line of contact will be addressed.

TASK II, ZONE 2 TARGET ACQUISITION, AND DESIGNATION FOR CANNON LAUNCHED GUIDED PROJECTILES

OBJECTIVE

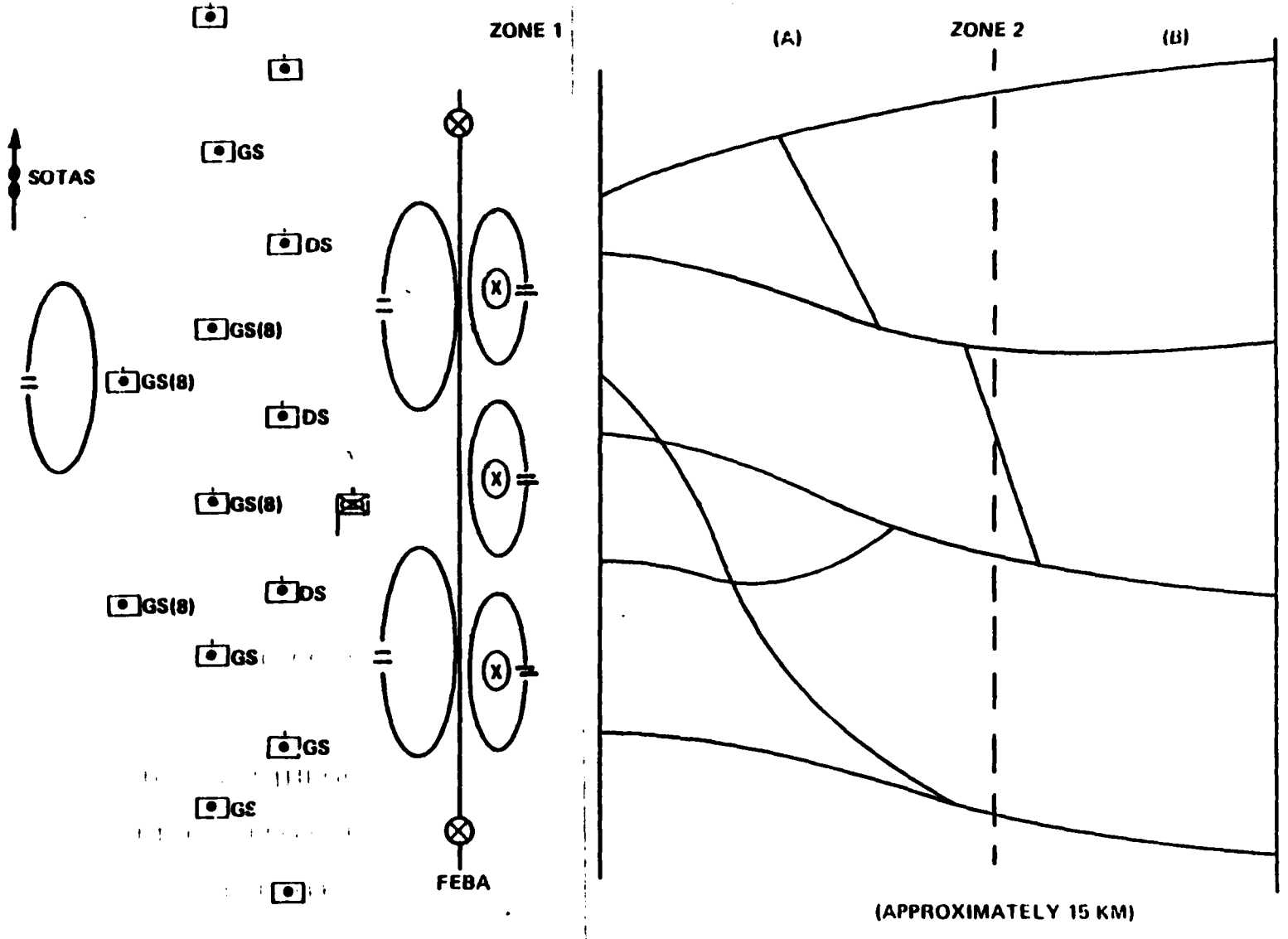
QUANTIFY THE EFFECTIVENESS OF SOTAS, FO RPVs AND CANNON LAUNCHED GUIDED PROJECTILES IN REDUCING THE PRESENTATION RATE IN ZONE I THROUGH DISRUPTION, DISORGANIZATION AND DESTRUCTION OF THE ARMORED FORCES IN ZONE 2

C. TACTICAL SITUATION USED FOR ANALYSIS

1. Ground. The study methodology is based upon a common U.S. defense lay-out as shown on the opposite figure, as well as a common road network for the enemy to use in Zone 2A. The road network assumes four main east and west roads into the combat sector, which is approximately a brigade width of 15-20 kilometers. Crossroads connecting the four main roads are represented, to complicate the problem of predicting where the enemy's force is likely to strike. Zone 2A is divided into two sections, a section from 5-15 kilometers from the line of contact, and a section from 15-30 kilometers from the line of contact. This division is important because the SOTAS has the potential capability to see targets moving along roads out to 30 kilometers beyond the line of contact, while the FO RPV in the foreseeable future can only be operated out to approximately 20 kilometers beyond the line of contact. The 15 kilometer division also is approximately the maximum range fly-out of the CLGP, with the M109A1 artillery placed at 5 kilometers behind the line of contact. For the purpose of this research, the direct fire attrition that takes place in Zone 1 (direct line of sight) will not be considered.

The three Red mechanized rifle battalions shown deployed along the FEBA represent the advance guard battalions forced to deploy after making contact with the Blue front line battalions. Not shown are 3 Red FA batteries of the Regimental Artillery Group (RAG) in the forward portion of Zone 2 in supporting range, or 24 additional batteries of the RAG and the Division Artillery Group (DAG) nearing readiness to fire. The second echelon maneuver battalions and regiments are also not shown.

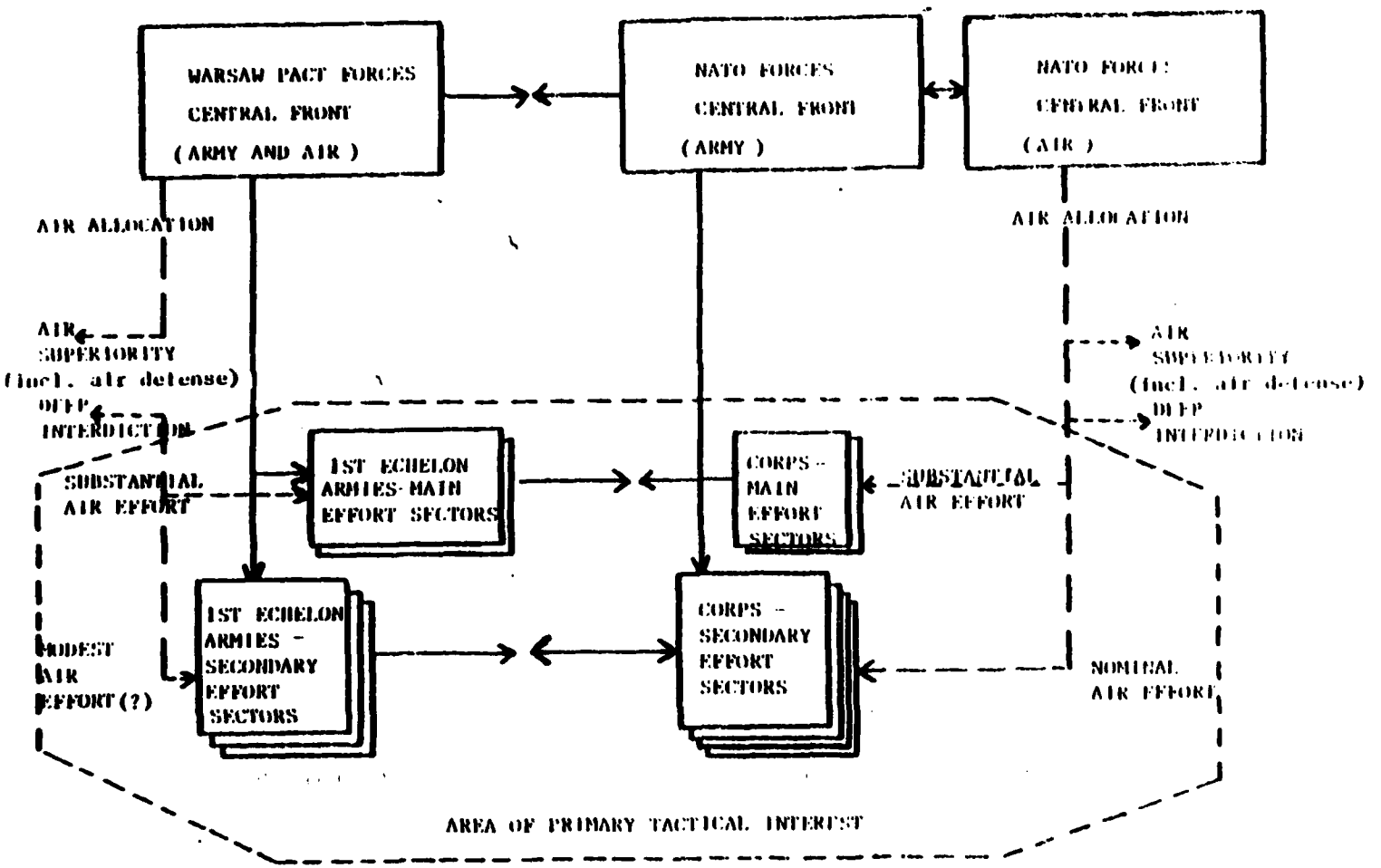
The Blue defending brigade has two maneuver battalions on line and one in reserve. The Blue artillery allocation to support the brigade is 11 batteries from the total of 10 divisional and non-divisional artillery battalions supporting the division in this scenario.


ZONE 1
ZONE 2
(A)
(B)
SOTAS
GS
DS
GS(8)
GS(8)
DS
GS(8)
DS
GS(8)
GS
GS
GS
FEBA
(APPROXIMATELY 15 KM)

2. Variations in Availability of Tactical Air Support. Targets in Zone 2A can theoretically be attacked by TAC AIR as well as by field artillery, but the allocations of limited Blue air assets will be to the Blue corps area of primary tactical interest. The adjacent chart, based on a "Threat Focused Concept," shows that there may be two different situations. On the entire front there would probably be two or three Soviet main effort attacks with strong air support, and other holding or secondary attacks still with army sized forces but less Front support to include less Frontal avaition. The allocation of Blue air support can be expected to be concentrated against the main attacks. It is assumed for the purpose of this analysis that one of the two U.S. Corps in Europe would face a main effort while the other would have to control and eventually defeat an attack by a Warsaw Pact Army sized force conducting a secondary effort. The next chart shows representative NATO allocation of TAC AIR against this type of threat. The conclusion is that either V or VII Corps will have to fight and win against a secondary attack; therefore, at least one U.S. Corps must control the Zone I presentation rate by use of organic artillery assets. The question is, how can this objective be achieved?

AREA OF PRIMARY TACTICAL INTEREST

AIR ALLOCATION



TAC AIR SUPPORT/DAY

NATO INVENTORY	2300 AIRCRAFT
OPERATIONALLY READY (85%)	1955 AIRCRAFT
SORTIES (1.5 SORTIES/DAY/A/C)	2932 SORTIES
OTHER THAN AIR DEFENSE	1466 SORTIES
SUPPORT AGAINST MAIN ATTACKS (3)	1173 SORTIES (391)
SUPPORT AGAINST SECONDARY ATTACKS (5)	293 SORTIES (59)
DIVISION SUPPORT AGAINST SECONDARY ATTACKS	30 SORTIES

EITHER THE V OR VII CORPS WILL HAVE TO FIGHT AND WIN AGAINST A SECONDARY ATTACK! THEREFORE AT LEAST ONE U.S. CORPS MUST CONTROL ZONE I PRESENTATION RATE BY USE OF ORGANIC ARTILLERY ASSETS!

HOW?

3. Success Criteria. Analysis of modern historical battles has traditionally credited defenders in prepared positions with the ability to hold off attackers of up to three times their numbers in force ratio. Experienced analysts have taken this idea further, in examination of a more fluid battlefield, as shown on the adjacent chart. The force ratios shown are measures of armored vehicles and major direct fire weapons, where some space is available for the defender to trade for time. Soviet doctrine and U.S. conventional wisdom indicates that the creation of local force ratios of 7:1 for any significant length of time will result in a breakthrough. The problem therefore is to maintain the local Zone 1 force ratios at least below 7:1 and hopefully at or below 3:1. These two force ratios were used as criteria for the Zone 2 attack requirements definition. Soviet force movement through Zone 2 can be controlled by delay, disorganization or attrition by either TAC AIR or artillery. Soviet values were then used to determine the actual impact of the attack alternatives. For example, the Soviet open literature states that force movement can be effectively cut in half (10-15 km/hr vs. 20-30 km/hr) if the force is required to move cross country instead of on improved roads. Further, if a unit sustains 25-30% damage it is delayed from entering the battle for 1.5 to 2 hours.

The research methodology, therefore, addressed both the Soviet breakthrough and the maneuver battle tactics using the same Blue defensive situation approach road network, and Soviet indicated attack timelines. Results were compared to force ratio build-ups of Zone 1 of between 3:1 and 7:1. Beyond 7:1 the Soviets were allowed to breakthrough.

CONVENTIONAL WISDOM, FORCE RATIOS IN ZONE I

(ANTIARMOR CAPABILITIES STUDY, BRAINSTORMING SESSION, OCT. 75)

R	(RED:BLUE)
2:1	FORCE BLUE HOLDS
3-4:1	MARGINAL CURVE
4-6:1	RED MOVE FORWARD
7:1	RED BREAKTHROUGH

- NATO FORCE TO WIN REQUIRES MAINTENANCE OF A MANAGEABLE PRESENTATION RATE IN ZONE I.

- SOVIET FORCE MOVEMENT IN ZONE 2 CONTROLLED (THROUGH DELAY, DISORGANIZATION AND ATTRITION) BY TAC AIR AND ARTILLERY

D. LIMITS OF FA EFFECTIVENESS IN REGION 2A WITHOUT CLGP

1. Simplified Analysis. One of the major recommendations of the Fire Support Mission Area Study was for the Field Artillery to double or triple the percentage of its assets devoted to targets beyond ground line of sight of the FEBA. To establish a baseline for comparing the SOTAS/RPV/CLGP (SRC) solution, the Task 2 analytical effort was initiated by a short evaluation of the effectiveness of unobserved, indirect fires into Zone 2A. As the purpose of this quick analysis was to identify trends and make comparisons rather than produce precise numbers, a number of simplifying assumptions were made, as shown on the accompanying chart.

2. The Artillery Duel. The data and assumptions used to analyze the artillery duel give the advantages of total numbers and maximum rates of fire to the Red artillery and the advantages of battery hardness and munition lethality to the Blue artillery. The Blue advantages are reflected in the smaller number of rounds required to achieve the 30% destruction criteria against an enemy battery. The total number of rounds required for either side is fairly large because Soviet criteria for material destruction is used for both sides (meaning that the batteries so hit stay out of action), and because target location errors and delivery system errors are built into the requirements for non-adjusted predicted fire techniques. A final simplifying assumption is that the quantities of ammunitions can be delivered by the respective logistic support system.

DATA AND ASSUMPTIONS FOR ARTILLERY DUEL

- BLUE MAX SUSTAINED RATE OF FIRE = 60 RDS/TUBE/HR
  USED FOR ENTIRE BATTLE
- RED MAX SUSTAINED RATE OF FIRE = 100 RDS/TUBE/HR
  USED ONLY FOR 1 HOUR PREPARATION; 30 RDS/TUBE/HR
  USED FOR REMAINDER OF TIME DUE TO PLANNING FACTOR
  OF 160 ROUNDS/TUBE TOTAL TO ACHIEVE BREAKTHROUGH
- BLUE ARTILLERY ALL ARMD SP (FOR RED EFFECTIVENESS PLANNING)
- RED ARTILLERY 50% TOWED AND 50% ARMD SP (FOR BLUE
  EFFECTIVENESS PLANNING)
- BLUE AMMUNITION 40% DP ICM AND 60% HE
- RED AMMUNITION 100% HE, w/Fz PD
- 30% DESTRUCTION CRITERIA AGAINST AN ENEMY BATTERY
  REQUIRES: 1800 HE ROUNDS FROM RED ARTILLERY
  280 ROUNDS (112 ICM & 168 HE) FROM BLUE,
  AND BATTERIES HIT WITH THIS CRITERIA REMAIN OUT
  OF ACTION
- DISPLACEMENT FOR SURVIVABILITY NOT PLAYED
- NO TIME LOST FOR TARGET ACQUISITION

The simplified FA duel attrition manual model is shown on the adjacent chart. Using this equation over successive one hour periods of both a massive breakthrough and a "daring thrust" attack from the march, Red and Blue losses are computed and the force ratios of the surviving artillery batteries are then measured. F, the fraction of artillery allocated to Zone 2A, means the allocation to that portion of Zone 2A (FM 100-5) that is "over the hill."

SIMPLIFIED FIELD ARTILLERY DUEL ATTRITION MANUAL MODEL

LOSS = B x F x N x R

B = NO OF BATTERIES IN RANGE, IN PLACE FIRING, AND DETECTED

F = FRACTION OF ARTILLERY ALLOCATED TO ATTACK OF ENEMY ARTILLERY BATTERIES IN ZONE 2A
(1-F) = FRACTION FIRING INTO ZONE I

N = NUMBER OF NEUTRALIZATION (30% DAMAGE) MISSIONS THAT CAN BE FIRED PER HOUR BY ONE BATTERY AGAINST ENEMY BATTERY(IES)

N IS FUNCTION OF:

MAX SUSTAINED RATE OF FIRE
ROUNDS REQUIRED TO ACHIEVE NEUTRALIZATION

FUNCTION OF:
- TARGET LOCATION ERROR } ASSUMED SAME
- DELIVERY SYSTEM ERRORS } FOR RED AND BLUE
- RELATIVE SOFTNESS OF ENEMY ARTILLERY DELIVERY SYSTEMS AS TARGETS
- MUNITIONS EFFECTIVENESS
- TACTICAL/TECHNICAL FIRE DIRECTION (ASSUMED EQUIVALENT FOR RED AND BLUE)

R = FRACTION OF MAX SUSTAINED RATE OF FIRE USED BECAUSE OF AMMUNITION CONSIDERATIONS AND SUPPRESSION

The model assumes a Red allocation of artillery 50% against other Blue targets. Rationale for this assumption is based on recent studies of pre-1973 Soviet writings such as the July 1976 BDM Report, "An Assessment of Soviet Forces Facing NATO - The Central Region and Supported NATO Initiatives," modified by Soviet writings resulting from the Arab-Israeli War of 1973. The earlier writings described an allocation of more like two thirds of Red artillery assets to counterfire, but the need for more suppression of the highly lethal direct fire anti-armor weapons, as demonstrated in 1973, has shifted the fraction closer to 50%.

The adjacent chart shows some outcomes of Red-Blue artillery duels using the assumptions and scenarios as described. The measure of Blue artillery "winning" or "losing" is the attainment of an irreversible domination of one side by the other. Because the Blue artillery would be numerically overwhelmed by waiting until all 52 Red batteries were within range, they initiated the counterfire duel at T=0 or when the Red 1st echelon battalions had made contact and deployed. When allocating only 20% or 50% to counterfire (F_B= 0.2; 0.5) the Blue artillery maintains a viable force ratio for several hours, but the combination of additional arriving Red artillery and a tripled Red firing rate during their one hour preparation starting at T+4 overwhelms the Blue artillery. When 80% of the Blue artillery is committed to counterfire, however, its hardness and lethality advantages permit it (1) to severely attrit the leading Red artillery batteries, (2) to survive the Red preparation and (3) to continue the Red attrition to the point of domination in about seven hours of firing. This is the "Blue Win" situation. The Daring Thrust scenario outcomes are similar, except that Blue artillery is able to dominate with only 50% in counterfire because the available Red artillery is only about half that for a massive breakthrough.

WITH RED ALLOCATION OF FIRES A CONSTANT 50% EA TO ZONES 1 & 2A (F_R = .5)

OUTCOMES OF RED - BLUE ARTILLERY DUELS:

FRACTION OF BLUE ARTY ALLOCATED TO COUNTERBATTERY FIRE MISSION

SCENARIO	F_B = .2	F_B = .5	F_B = .8
BREAKTHROUGH	BLUE LOSE	BLUE LOSE	BLUE WIN
DARING THRUST	BLUE LOSE	BLUE WIN	BLUE WIN

3. Other Targets in Zone 2A. The allocation of 80% of the Blue artillery assets to the counterfire role in Zone 2A means, of course, that only 20% remains to attack Red targets directly in front of the Blue defenders on the FEBA. The result is that the Blue direct fire weapons are not effectively suppressed by the attritted Red artillery, but they still must win against superior numbers of Red direct fire weapons. The Red maneuver forces in Zone 1 consist primarily of maneuvering tanks and armored personnel carriers, not profitable targets for the Blue artillery with the limited time available. The softer Red targets are in Zone 2. Soviet tactics call for their armored columns to normally occupy assembly areas just prior transitioning in Zone 2A from a road march to assault formations. In order for the Red forces to arrive at the FEBA with relatively fresh personnel, full fuel tanks and ammunition loads, these assembly areas are planned to be within reach of Blue long range artillery. The figure is a sketch of how one of these assembly areas might be set up.

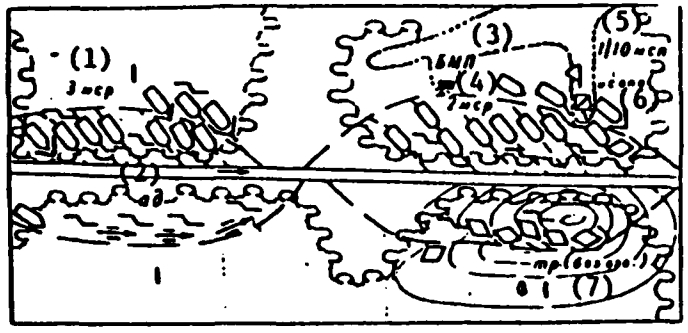


FIGURE 15. DEPLOYMENT OF THE BATTALION IN A REST AREA (A VARIATION)

KEY: (1) THIRD MOTORIZED RIFLE COMPANY
(2) ARTILLERY BATTALION
(3) BATTALION AID STATION
(4) SECOND MOTORIZED RIFLE COMPANY
(5) 1/10 MOTORIZED RIFLE REGIMENT
(6) COMBAT ENGINEER PLATOON
(7) TANK COMPANY (LESS ONE PLATOON)

"ENGINEERING SUPPORT OF THE MOTORIZED RIFLE (TANK) BATTALION ON THE MARCH AND IN THE MEETING ENGAGEMENT", MOSCOW 1975 page 56.

An excursion of the simplified attrition model was run against Red battalion assembly areas in Region 2A, using the assumptions in the accompanying chart. Acquisition of these large area targets is by SOTAS, supplemented by the RPV. The purpose is to reduce the buildup of the force ratio in Zone 1 by delaying the second echelon battalions and regiments.

Without any attrition or delay of these second echelon forces, the Red to Blue force ratio of maneuver, or direct fire, units in Zone 1 is greater than three across the brigade front by the start of the Red preparation at T+4, and is even greater across the narrow breakthrough sector. The model indicates that attacking Red assembly areas with the remaining 20% of the artillery not allocated to the counterfire mission keeps the maneuver force ratio at three or less for a seven or eight hour battle. Only DPICM ammunition was used in this assembly area attack utilizing a U.S. artillery battalion level Time on Target (TOT) attack on a company sized assembly area every five minutes. Personnel of companies hit by such a TOT were determined to be neutralized and therefore held out of combat for two hours in accordance with Soviet writings.

ARTILLERY ATTRITION OF MANEUVER UNITS

SAME DATA AND ASSUMPTIONS AS FOR ARTILLERY DUEL EXCEPT:

- BLUE AMMUNITION 100% DP ICM
- BLUE ATTACKS RED ASSEMBLY AREAS IN ZONE 2 WITH 20% OF AVAILABLE BLUE ARTILLERY; ONE BATTALION TOT EVERY 5 MINUTES. WHENEVER ALL ASSEMBLY AREAS ARE NEUTRALIZED, BLUE ARTILLERY DIVERTS FIRES TO RED MANEUVER UNITS IN ZONE I
- NEUTRALIZATION OF MANEUVER UNITS IS EFFECTIVE FOR 2 HOURS, AFTER WHICH TIME THEY ARE PUT BACK IN ACTION ACCORDING TO RED NORMS FOR NEUTRALIZATION.
- DIRECT FIRE ATTRITION IN ZONE I NOT PLAYED
- R/B FORCE RATIO MEASURED IN ZONE I (FEBA)

4. The need to do better. The model uses assumptions mostly favorable to Blue artillery, but the effectiveness of reducing the Zone 1 presentations is marginal at best. Therefore, a better solution that includes more attrition in Zone 2A is required.

The adjacent chart shows artillery ammunition expenditures for the breakthrough scenario described. The average of 311 rounds used per tube represents the bulk of what would be fired during the battle day because the Reds would not have achieved their penetration or outcome window. Actually 50 rounds per 155 mm tube and 25 rounds per 8" tube were used resulting in 350 and 175 rounds per tube, respectively, to be expended. These figures are not out of line with recent Army estimates, such as the Ammunition Rates Study.

ARTILLERY AMMUNITION EXPENDITURES, BREAKTHROUGH

- ALL RED BATTERIES HAVE 6 TUBES
- BLUE BATTERIES: 155 - 7 x 6 = 42 TUBES, 60 RDS/TUBE/HR MAX
  8" - 4 x 4 = 16 TUBES, 30 RDS/TUBE/HR MAX
- RED FIRES 7 HR TOTAL 16,267 RDS
- BLUE FIRES 7 HR TOTAL 12,963 (84% 155, 16% 8")

AVERAGE RDS/TUBE = 311 RDS IN 7 HRS

AVERAGE RDS/TUBE/HR = 44 (50/HR 155) (25/HR 8")
(AVE TUBES AVAILABLE OVER 7 HR PERIOD)

The ability of Red maneuver elements to reach Zone I when not delayed through disruptions, disorganization and destruction, is represented by the movement rates on this chart.

SOVIET BATTALION MOVEMENT RATES

25 KM/HR	COUNTRY ROAD
20 - 35 KM/HR	HIGHWAY
20 KM/HR	TOWNS
10 - 15 KM/HR	POOR TERRAIN
10 - 15 KM/HR	FAST ASSAULT
5 - 10 KM/HR	ASSAULT FIRE BY SHORT HALTS

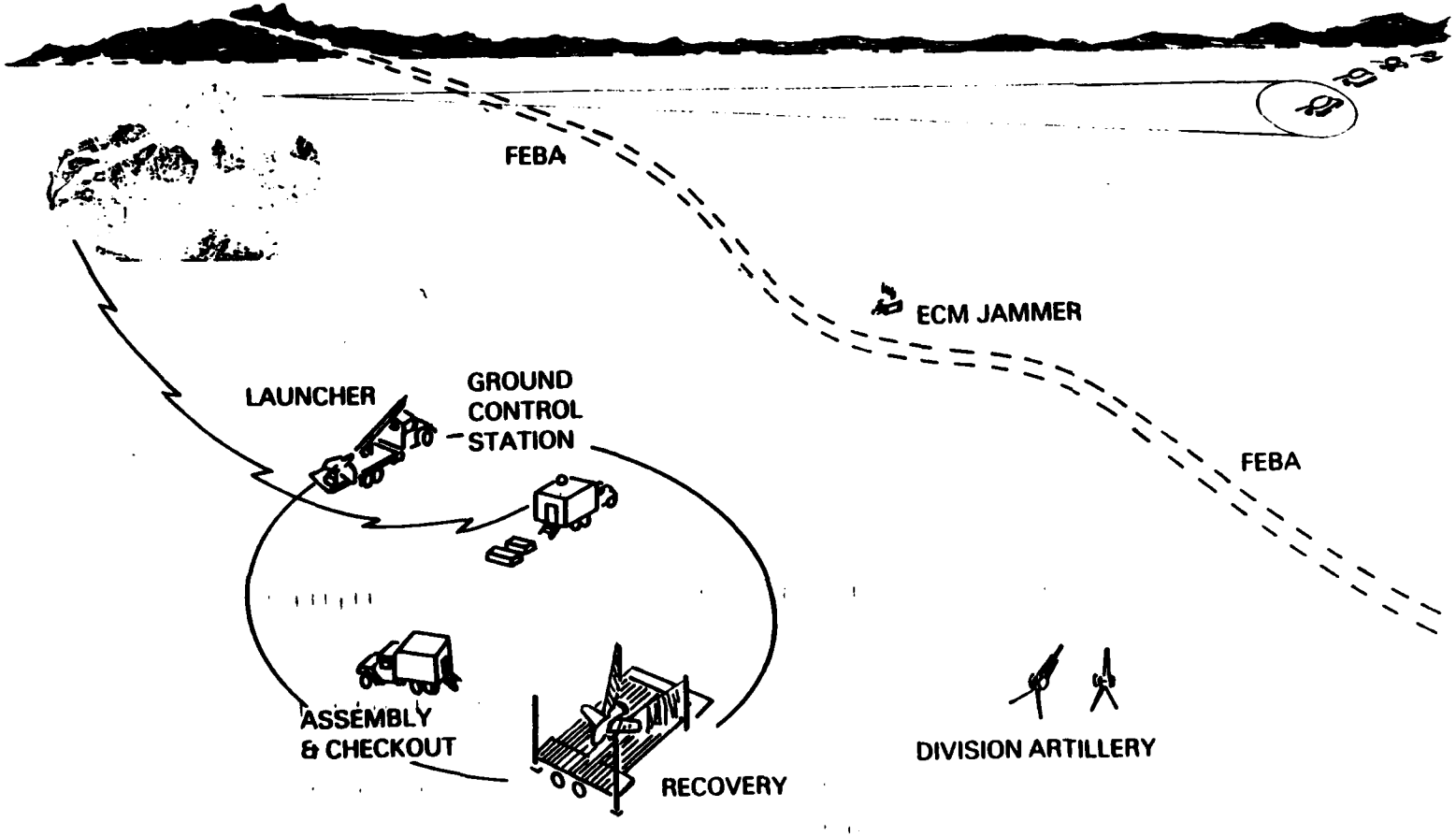
E. CONCEPTS OF EMPLOYMENT

Since the total usage of artillery in Zone 2 yields only marginal success against the armored forces for both the breakthrough and daring thrust tactics, an operational Zone 2 armor attack system consisting of the SOTAS, RPV and Copperhead was developed. All of these systems are scheduled to be in the European operational inventory by the early 1980's. Each of these individual systems have significant limitations; however, when combined with the explicit objective of Zone 2 armor attack, the resultant system stands to exert significant influence on the enemy tactics particularly in support of the Corps that must defend against a secondary attack.

The SOTAS, operating at a safe distance from the Forward Edge of the Battle Area (FEBA), will detect the armored column coming into Zone 2A from 20-30 kilometers and pass that information from the SOTAS ground station to the RPV ground control station. Upon receipt of this information and release from higher headquarters, the RPV ground control station will command the launch of an RPV to fly to a pre-designated position approximately five kilometers from the line of contact and in close proximity to the main avenue of the armored threat approach. Since the Soviets indicate that combat units move at 20-35 km per hour over improved roads, the SOTAS/RPV interface would have from 25 to 75 minutes to accomplish the requisite coordination. The RPV with a Copperhead designator would provide designation for a two gun artillery platoon to be used in a closed loop fashion to develop a linear, road based kill zone similar to the direct fire kill zone concept outlined in FM 100-5 and implemented by V Corps through the Battalion Commander's Battle Book. The Zone 2 artillery kills would be directly related to direct fire kill zones.

OPERATIONAL SYSTEM

SOTAS DETECTS COLUMN IN
ZONE 2 AND CUES FO RPV



At that time, the RPV will be used to observe a check round fired at a known point within transfer limits for a Copperhead aiming point along the road ahead of the column. When the armored column comes within acquisition range of the RPV, the RPV will be used to command the automated launch sequence of Copperhead rounds to start, and will designate targets at prescribed intervals as it flies parallel to the armored column. The RPV will fly up and down the armored column, designating as it flies, until it extracts the requisite attrition according to Soviet norms for reduced combat effectiveness. This SOTAS, FO RPV and Copperhead attack concept is designated the "road runner" concept.

Problems with this concept that need hard quantification test type data are:

(1) Susceptibility of SOTAS to jamming;

(2) Susceptibility of the RPV ground control station to jamming/attack;

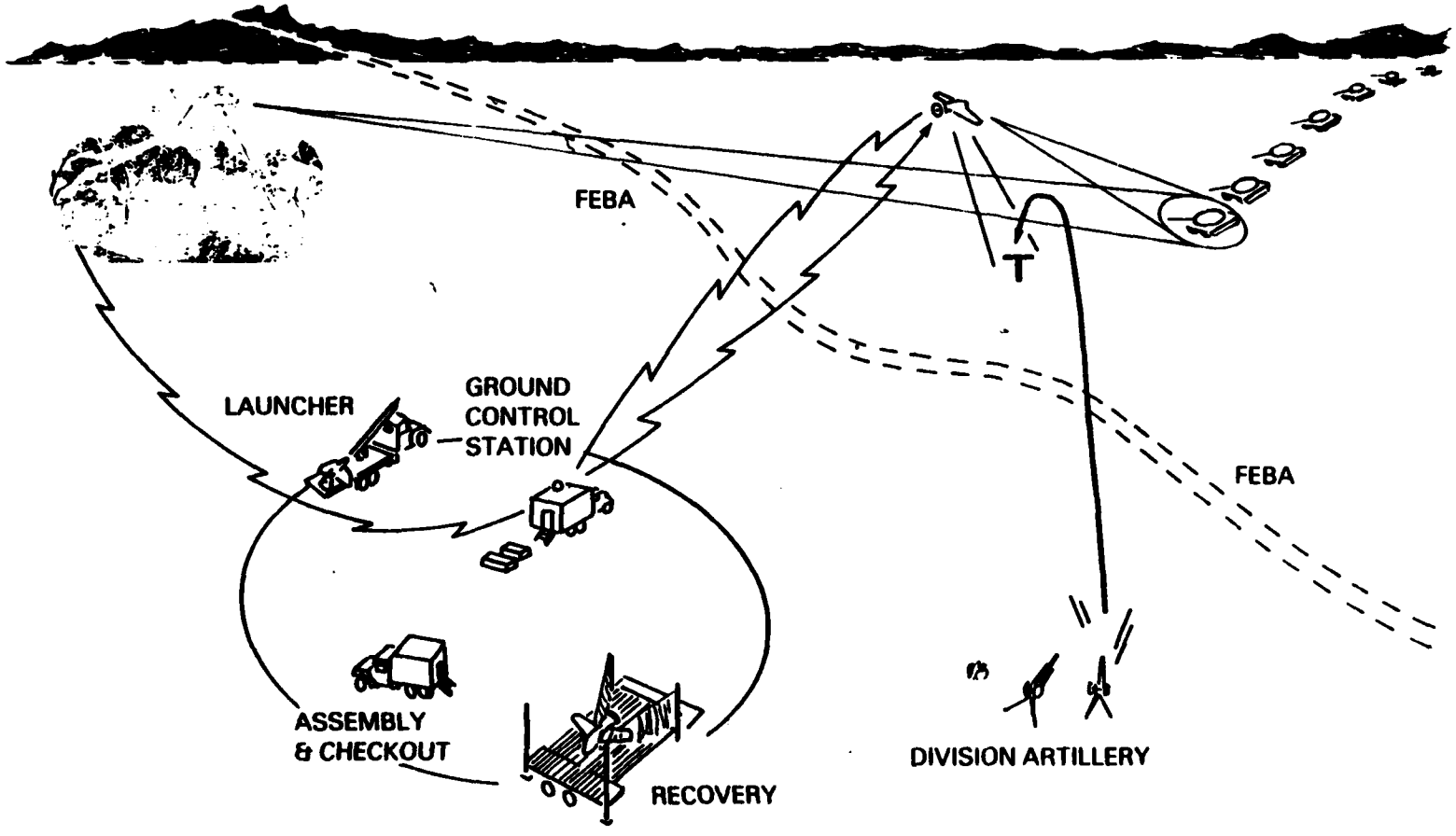
(3) Susceptibility of the RPV to jamming/attack when operating at maximum reliable designator off-set distance from the armor convoy;

(4) Demonstration of the single shot propability of kill of the Copperhead in this configuration;

(5) Communication network and timelines to make the system work.

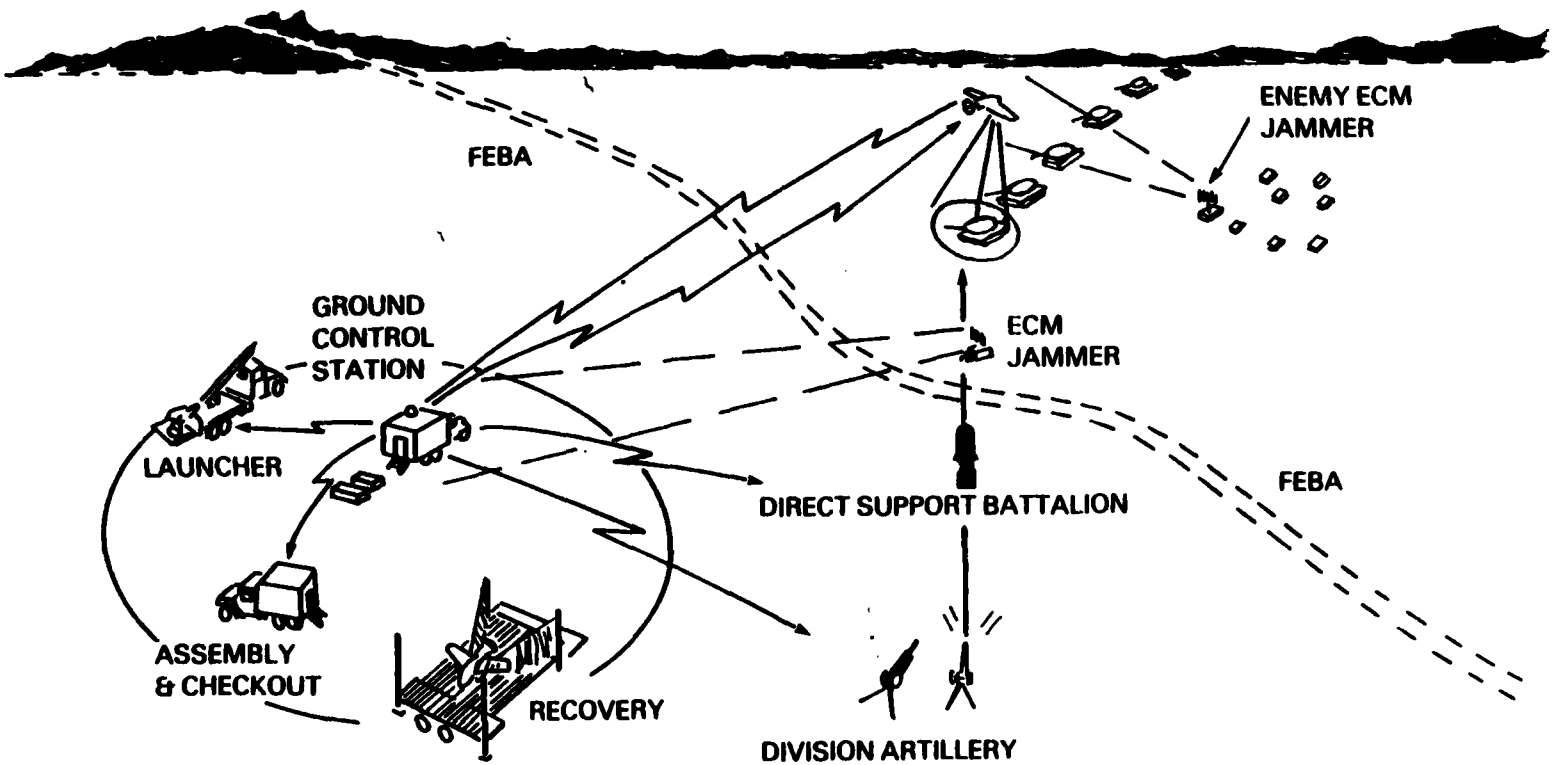
OPERATIONAL SYSTEM

FO RPV DETECTS COLUMN AND SPOTS
ARTILLERY CHECK ROUND NEAR KNOWN POINT



OPERATIONAL SYSTEM

FO RPV FLIES "ROAD RUNNER" TRACK AND
DESIGNATES ARMORED VEHICLES FOR COPPERHEAD



For attacking artillery batteries in defilade and preparing to fire a second SOTAS/FO RPV/Copperhead attack concept was considered: the counterbattery "race track" concept. In this latter concept, a RPV would be assigned to fly a race track type pattern over the area norminally occupied by the Soviet artillery or 3 to 15 kilometers from the line of contact. When it locates a towed artillery battery, the RPV system simply locates the position of battery for attack by the U.S. artillery. When a self propelled and armored Soviet artillery battery is located, the RPV would orbit the battery designating enemy guns for Copperhead attack.

This "find before fire" concept for accomplishing the counterfire mission could well provide within logistic constraints the critical lever to overcome the introduction of the armored, self propelled artillery into the Warsaw Pact inventory. Further, should a DPICM round ever be developed by the Warsaw Pact, this concept may well make the deciding difference in the counterfire duel.

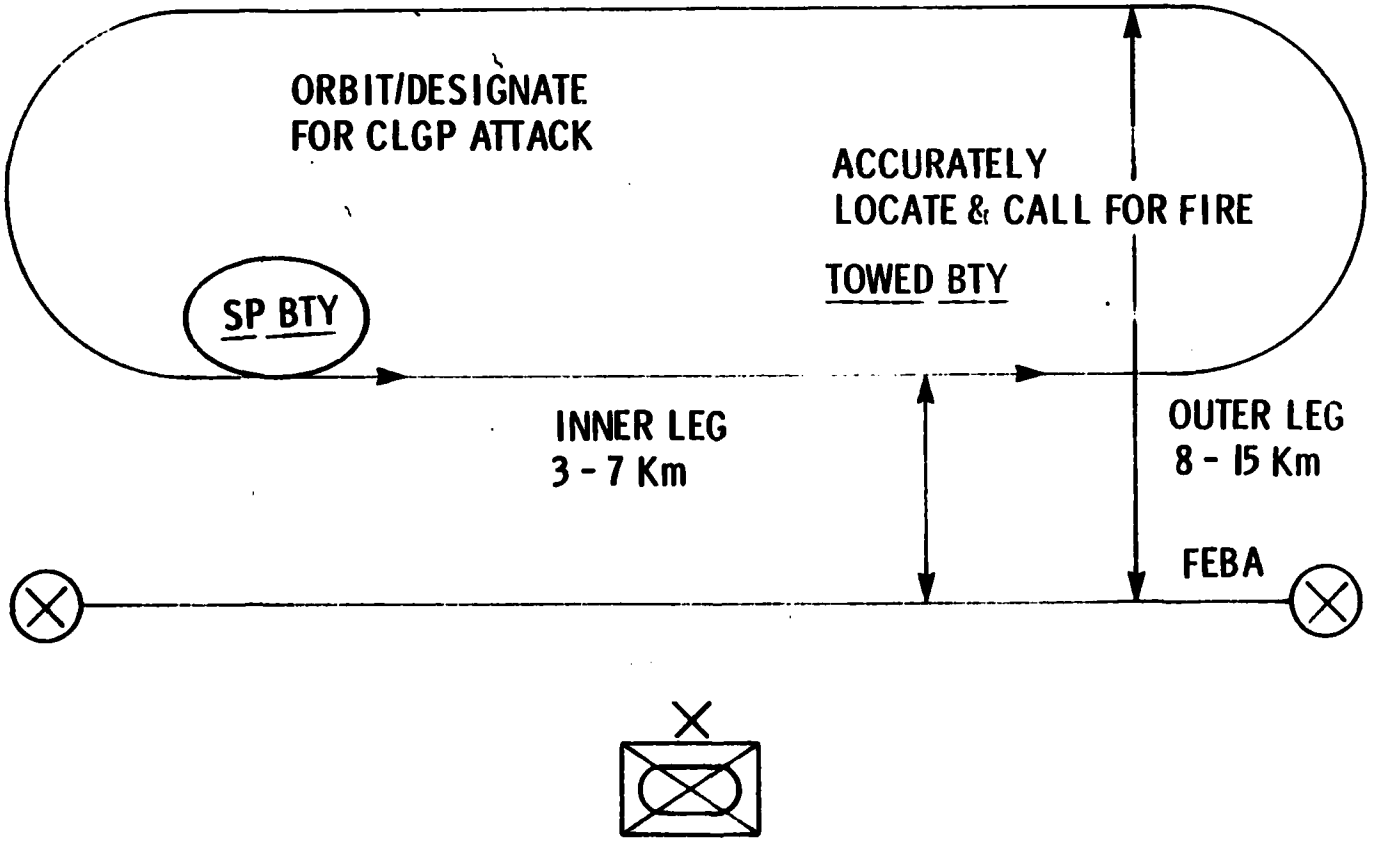
The race track concept would tie two two gun platoons from different 155 mm batteries to a single RPV. The two platoons are required because of the depth and breadth of the RPV coverage. Towed artillery suppression missions would be handled through the normal TACFIRE system while armored self-propelled artillery attack would be handled via a quick fire channel from the RPV ground station to the BCS of the support artillery batteries.

RACE TRACK CONCEPT

FOR FUTURE COUNTER BATTERY

"FIND BEFORE FIRE" ATTACK

(ASSUMES SOVIET ARTILLERY 50% TOWED AND 50% SP ARMORED)



The chart shows the major FO RPV characteristics used for this analysis.

RPV OPERATIONAL CHARACTERISTICS

(OPERATIONAL AND ORGANIZATIONAL CONCEPT FOR COEA)

GCS STANDOFF FROM LOC	3-10KM
MISSION PLANNING TIME	2.5 HRS
GROSS WEIGHT	125-200LBS
PAYLOAD	50LBS
AIR SPEED	MAX 240KM/HR
ALTITUDE	UP TO 12000FT
ENDURANCE	3 HRS AT 110KM/HR
RADAR CROSS SECTION	MAX 0.1 M^2
DETECT TANK ON ROAD (TV)	5KM

AQUILA CHARACTERISTICS

GCS TO RPV	20KM
N/A	1.5-2 HRS
GROSS WEIGHT	133-146LBS
PAYLOAD	50 LBS
AIR SPEED	69-165KM/HR
MAX CRUISE ALT OPERATIONAL ALT	7000FT 2000FT
ENDURANCE	2.5 HRS AT 110KM/HR
WING AREA	2.9 M^2
DETECT TANK ON ROAD (TV)	3KM

MINIMUM SYSTEM CHARACTERISTICS

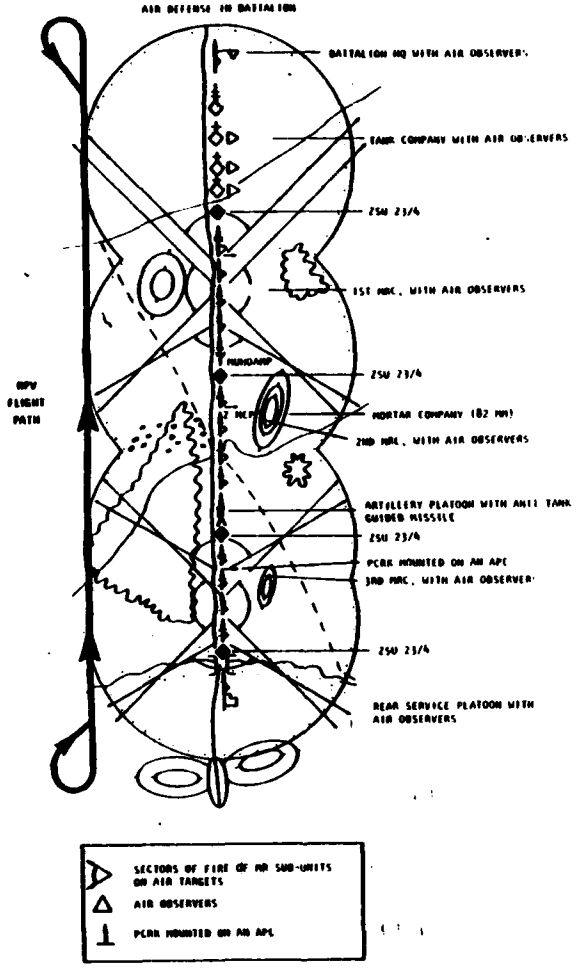
MSC-2.5 (1976-80)

CAPABILITY	RSTA RANGE FINDING LASER DESIGNATION
RANGE FORWARD OF LOC	3-20KM (50 BY 1985)
SENSORS	DAY NIGHT ADVERSE WEATHER

F. MANEUVER UNIT ATTACK

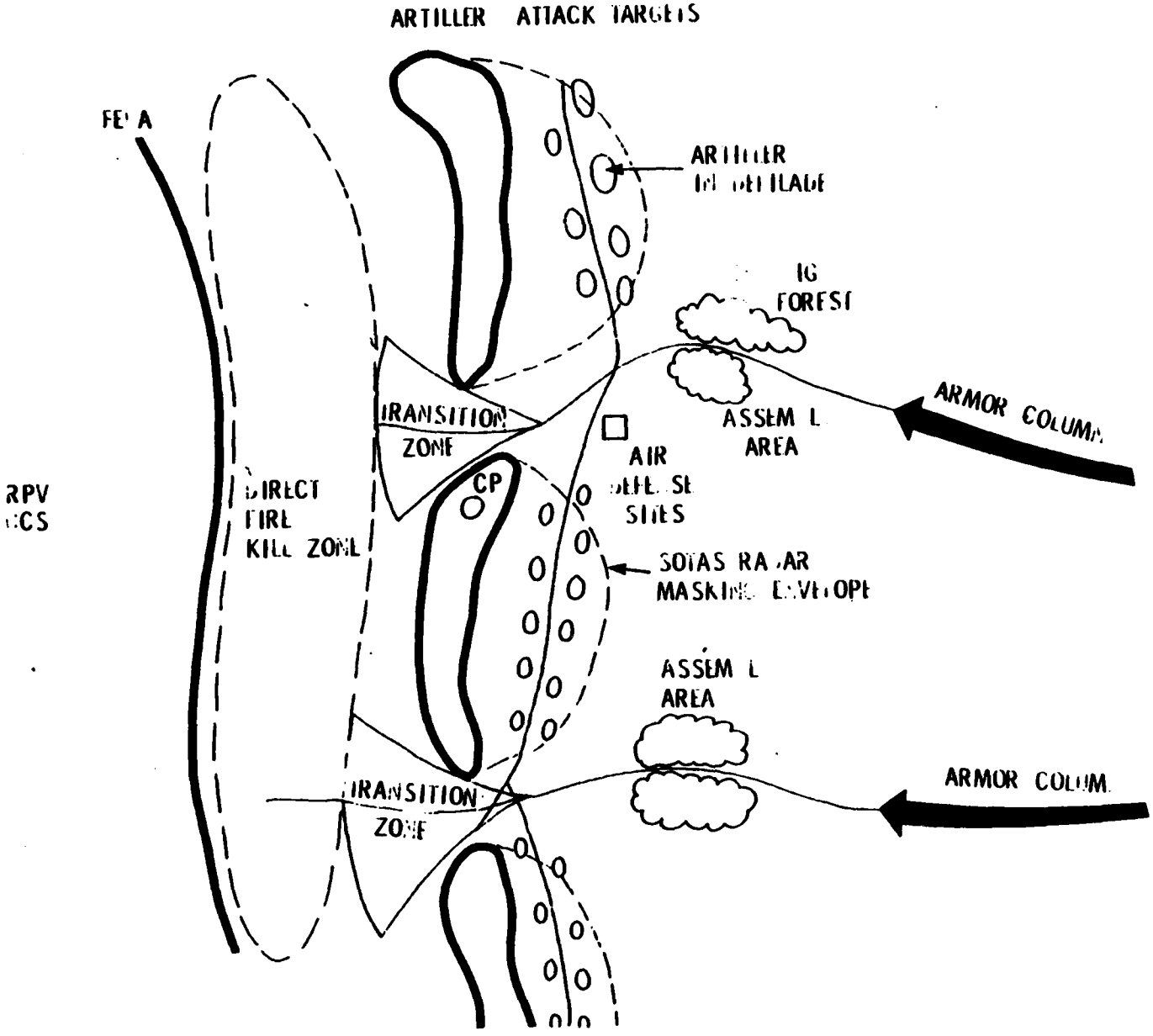
An example taken from the Military Herald published in Moscow in August 1976 indicates how the air defense is laid out for a motorized rifle battalion on the move. The objective of the FO RPV, once cued into position by SOTAS, would be to fly along the length of the motorized rifle battalion which is on the road as shown in the figure opposite, at an offset distance of approximately 1.5 to 2.5 kilometers or outside the most dangerous portion of the ZSU 23-4 air defense gun envelope for an RPV sized target. The RPV would designate the armored vehicles anywhere from 45° from the gun vehicle center line to perpendicular to the center line. The side of the road selected for the flight will be the one which minimizes the angle between the designator and the gun at the targets. The RPV will fly the full length of the battalion column, or approximately 10 kilometers, conduct a turn outside of the envelope of the ZSU 23-4, and proceed back along the line of the column, designating it as it returns. One to three complete cycles of RPV flights along this column should be sufficient to satisfy the Soviet criteria for combat unit neutralization of 20-30% losses, based upon the single shot probability of kill given for Copperhead using a RPV laser designator operating 1.5 to 2.5 kilometers offset from the column. Should the motorized rifle battalion determine that the losses being sustained by the RPV/Copperhead attack are sufficient to require them to go to offroad maneuvers, their forward velocity will have been cut at least in half and, therefore, their ability to present large numbers of vehicles into Zone I significantly degraded. Should this occur, however, it would provide an excellent target for artillery delivered scatterable mine attact. Since mines work best in offroad conditions, the synergism of the RPV/CLGP attack and the mine attack in response to the offroad maneuver could be significant.

ROADRUNNER CONCEPT



SOURCE: BULATOV, A. COL., & POLYAKOV, I., COL., "AIR DEFENSE IN BATTALION" VOYENNYY VESTNIK, MOSCOW, AUGUST 1976, p. 87.

This figure depicts the types of targets that could be attacked by the SOTAS/RPV/Copperhead attack system. As previously discussed, the RPV could attack the armored columns as they came in along the roads, as shown at the far right hand side of the figure. This attack system could further be used to attack the armored combat units after they have reached assembly areas within U.S. artillery range. The SOTAS, in this latter instance, would detect that the vehicles moved into the tree line that is along the road. At that time, the SOTAS could cue the RPV to search with its forward looking IR sensor the treed area along the road to determine exactly where the tanks departed the road and call in conventional artillery strikes on those areas. Should battalion sized time-on-target (TOT) strikes be fired against company size assembly areas, sufficient attrition to meet the Soviet norms of 25-30% casulties of neutralization of the combat unit personnel might be achieved with one to three battalion volleys, depending on the RPV target acquisition accuracies. The next target for this SOTAS/RPV/Copperhead attack system in Zone 2 could be the Soviet artillery firing or preparing to fire, from defilade. The SOTAS could detect the artillery batteries moving into defilade parallel to the line of contact and cue the RPV to fly a line parallel to the line of contact designating from an orbiting pattern the self-propelled armored artillery for Copperhead attack, and locating the towed artillery for conventional artillery attack. Since the gun air defenses are not normally associated with the artillery operating in defilade, the orbital attack around an artillery battery by the RPV could be effective without substantial risk or loss of the RPV. Should the counterbattery RPV detect an air defense system, either gun or missile, it could then orbit that air defense system at 2.5 kilometers distance, and call in Copperhead or DPICM strikes against that target. This would attrit the enemy air defenses to a level in which tactical aviation could be brought to bear in the transition zone. This zone is defined as that area where the enemy's maneuver force transitions from a one dimensional armored column to a highly dynamic two dimensional assault group in preparation for its entrance into the direct fire or assault region.

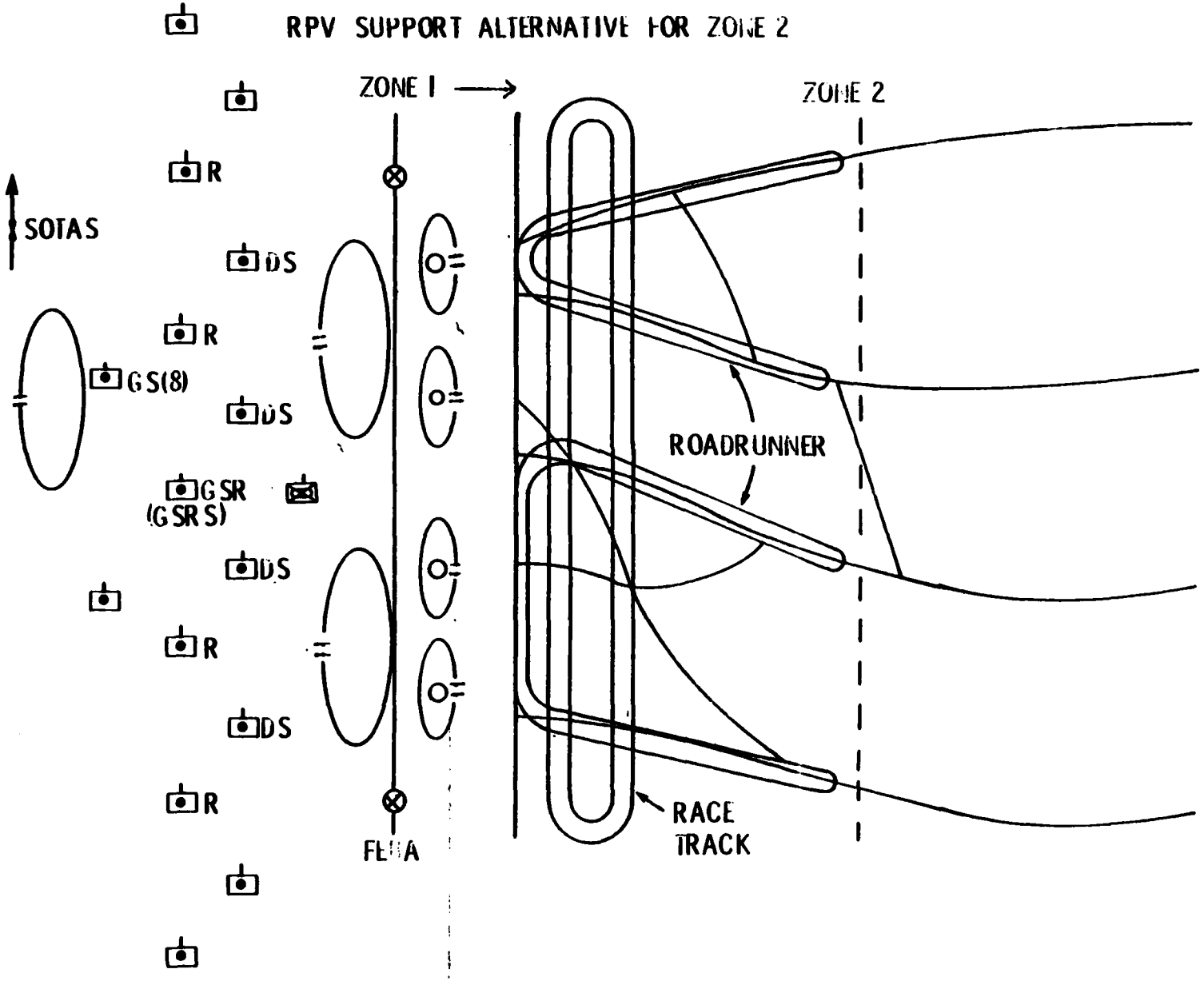

ARTILLER ATTACK TARGETS
FE' A
ARTILLER
IG FOREST
ARMOR COLUM
IRANSITION
ZONE
ASSEM L
AREA
AIR
CP
RPV
CS
DIRECT
FIRE
KILL ZONE
SOTAS RA AR
ASSEM L
AREA
ARMOR COLUM
IRANSITION
ZONE

For a Soviet breakthrough attempt in which regimental columns, each consisting of battalions separated by upwards of five kilometers to meet nuclear safety criteria, could be attacked while on the main roads by the use of two "Road Runner" RPVs cued into position by a single SOTAS. The first RPV would operate on two roads, starting at approximately five kilometers beyond the line of contact on one of the roads and flying up and back along that road designating the targets as it went. It then would fly to the next main east-west road, and fly up and back on that road, again designating as it went. The Copperheads would be fired at pre-planned intervals using pre-planned kill zone planning concepts similar to the direct fire kill zone concepts currently being developed in Europe. These artillery kill zones, however, would be oriented along roads in Zone 2A, and would have a direct effect on the presentation of the armored assault vehicles into Zone 1. The second armor attack RPV would also position itself on one of its two roads of primary consideration. Upon seeing the initial vehicle, it would fly up and back on that road, then transition over to the next road and repeat the same sequence. The RPVs would oscillate back and forth between their two primary road requirements until Soviet norms for attrition had been attained, the RPV had been neutralized by the air defenses, or the RPV mission time had run out.

The "Race Track" RPV, assigned the primary mission of counterfire and a second mission of air defense attrition, would fly parallel paths back and forth in a region from 3-15 kilometers beyond the line of contact. As was stated before, this RPV would identify self-propelled, armored artillery and orbit that battery until sufficient Copperheads had been fired to neutralize the battery before proceeding on in its parallel flight path. Upon identifying a towed artillery battery the RPV would simply indicate the target location for future TACFIRE scheduled attack by conventional or dual purpose improved conventional munitions. Upon detecting a semi-fixed air defense system, the "Race Track" RPV would orbit at approximately 2.5 kilometers from the air defense system and designate that threat for Copperhead attack.

If a daring thrust attack from the march were detected by the SOTAS aircraft, based upon the numbers and sizes of the columns moving into Zone 2A, then only the two armor column attack RPVs would be required. The counter-battery RPV, based upon the simplified artillery attrition model, would not be required since the artillery force ratios in the initial phases of the meeting engagement would not exceed the ability of the U.S. artillery to draw down the Soviet artillery at an acceptable rate. Since the Soviets normally move in a column into the battle area at a rate of approximately 20 kilometers per hour, and the RPV would not have to be in position and ready to attack the armored columns until they are approximately 5 kilometers from the line of contact, this would allow in excess of one hour for the SOTAS to detect vehicular movement, determine the magnitude of the impending attack and cue the appropriate amount of RPVs into position.

RPV SUPPORT ALTERNATIVE FOR ZONE 2



These are some of the key descriptions of the techniques for employing the FO RPV described so far.

Since the Forward Observer Remotely Piloted Vehicle (FO RPV) is the critical element that ties the Stand-Off Target Acquisition System to the Cannon Launched Guided Projectile, the FO RPV employment will be addressed in detail at this time for Zone 2 operation. The critical Zone 2 targets and resultant RPV functions are basically to operate against moving targets and semi-fixed targets in Zone 2. For the moving targets, such as armor battalions, the RPV will be required to designate the vehicles within the battalions, moving on the road, for CLGP attack. When artillery is detected on the road, the RPV would first identify whether the artillery was towed or armored self-propelled units. If the unit is a towed artillery unit, then the RPV could adjust fire on that unit. If the unit is armored and self-propelled artillery, then the RPV could attempt to designate the individual guns for Copperhead attack.

When air defense units are detected moving on the road, the RPV would stand off at a distance approximately two and onehalf kilometers and adjust fire on the air defense units. If battalion command post vehicles are noted on the road, the RPV would also adjust fire on those units.

For semi-fixed targets or targets that have recently moved into position for attack, the RPV would have the responsibility to locate only, adjust fire, or designate for Copperhead attack, depending upon the type of systems located as shown in the figure on the opposite page. To assist the RPV in improvement in the accuracy of location of targets in Zone 2, the following schemes have been identified. First, the moving target indicating sensor would cue the RPV into position to detect and identify the target. Assuming that the targets are moving on improved roads as the Soviet doctrine seems to indicate, and that the roads can be distinguished by key features along the individual roads, then a target location error of from 100 to 200 meters for the pre-planned kill zones would appear to be adequate for Copperhead attack. This type of target location error is well within the capability of the current FO RPV under these conditions. For the semi-fixed targets, in which the moving target indicating sensor has only given the general location to the RPV, map analysis by the RPV operator coupled with possible use of a laser range finder could also meet the 100 to 200 meter target location error in the pre-planned kill zones.

To enhance the overall system accuracy, it is proposed that a pre-attack gun registration be conducted. The fire would be conducted at a key map feature, such as a road junction or a farm house along the road on a consideration for the Road Runner concept. Pre-attack gun registration rounds would then be fired at the key map feature, and the miss distance measured by the laser range finder on the RPV. This pre-attack gun registration could be accomplished during the 25 to 75 minutes allotted between the first time that the moving target indicating sensor detects the targets and the RPV must start its Road Runner attack.

SUGGESTED FO RPV EMPLOYMENT IN ZONE 2

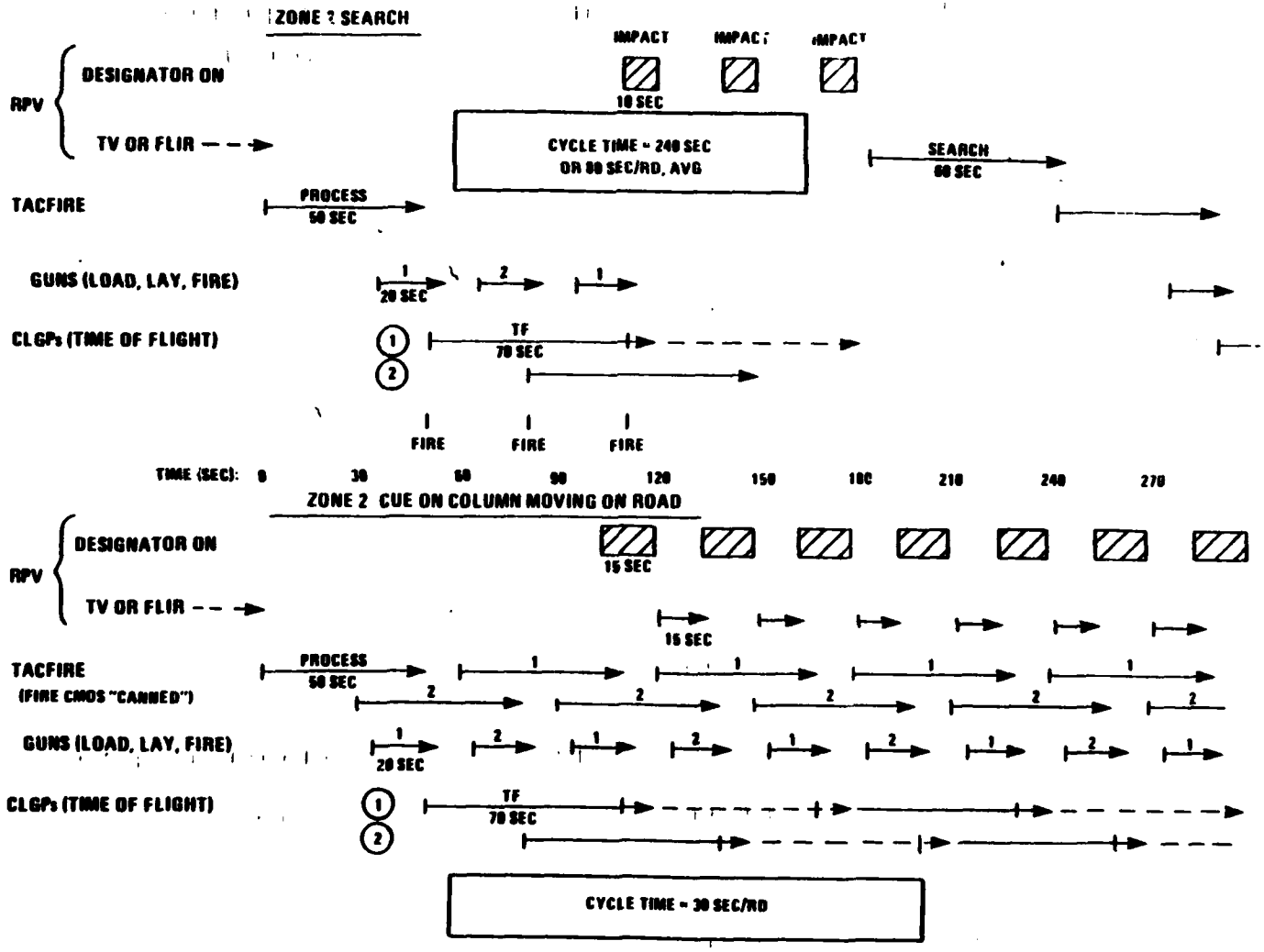
- CRITICAL TARGETS/KEY RPV FUNCTIONS
  - MOVING TARGETS - ARMOR BATTALIONS (DESIGNATE)
    BOTH TOWED (ADJUST) & SP ARTY BATTERIES (DESIGNATE)
    AIR DEFENSE UNITS (ADJUST)
    BATTALION CPs (ADJUST)
  - SEMI-FIXED TARGETS - BOTH TOWED (LOCATE) & SP ARTY BATTERIES (DESIGNATE)
    ARMOR ASSEMBLY AREAS (LOCATE)
    AIR DEFENSE SITES (LOCATE/ADJUST)
    BATTALION CPs (ADJUST)
- ACCURACY IMPROVEMENT SCHEMES - MTI SENSOR CUES FO RPV
  - 100 - 200 METER TLE (PRE-PLANNED KILL ZONES) - MOVING TARGETS - ON ROAD (ONE DIMENSIONAL) + KEY FEATURES ALONG THE ROAD
    SEMI-FIXED - MAP ANALYSIS PLUS LASER RANGE FINDER
  - PRE-ATTACK GUN REGISTRATION (PRE-PLANNED REGISTRATION POINTS) - FIRE AT KEY MAP FEATURE (ROAD JUNCTURE, FARM HOUSE)

SUGGESTED FO RPV EMPLOYMENT IN ZONE 2 (CONTINUED)

- QUICK FIRE CHANNELS REQUIRED FOR SURGE CONDITION
  - BREAKTHROUGH - DIVARTY, ONE BRIGADE AND DIVISION G-2 RPV SECTIONS DEDICATED TO LOCATING / DESIGNATING ARTY BATTERIES BEFORE THE PREP AND MANEUVER UNITS
  - MEETING ENGAGEMENT - DIVARTY AND BRIGADE RPV SECTIONS DEDICATED TO LOCATING / DESIGNATING MANEUVER UNITS ON THE ROAD AND ARTY BATTERIES
  - OTHER - DIVARTY RPV SECTION DEVELOP ZONE 2 TARGETS SUCH AS SUPPLY POINTS, CPs AND ARTY
- SOVIET COMBAT EXPERIENCE AND CURRENT TRAINING STRESS THAT ZONE 2 SURGE BUILD-UP BE CONDUCTED AT NIGHT TO ALLOW DAY-LIGHT HOURS TO SECURE THE DAY'S OBJECTIVES

The chart opposite shows two sets of time lines for two techniques of RPV use in Zone 2. The top section describes the "Race Track" sequence from target detection, identification and attack by the RPV through impacts of three Copperhead rounds assumed to be required to kill a hard target. The average cycle time per round is 80 seconds, assuming 60 seconds for the RPV to search for each new target. The lower section describes the sequence of events for two guns firing CLGP on a "Road Runner" mission. Because of the preplanned nature of the targeting and limited requirement for searching, the cycle time is only 30 seconds per round for the same probability of kill.

RPV/CLGP ATTACK ALTERNATIVES USING PREPLANNED AIM POINTS IN ARTILLERY KILL ZONES



Assuming a single shot probability of kill for the Copperhead of 0.33, it is estimated by artillery mission and Warsaw Pact attack type that the number of Copperhead rounds required are as shown. For the counterfire mission against the breakthrough either 11,567 rounds would be required without the RPV and Copperhead, or approximately 1,950 rounds of which 225 were Copperheads to be fired against the armored self-propelled artillery would be required with the RPV and Copperhead. The 225 Copperhead rounds, if fired from two two-gun platoons in each of two batteries, would require approximately 56 rounds to be fired per tube over an eight hour period. For the counter-mobility mission, there is also a trade-off between attacking the personnel of the armored combat units in assembly areas with time-on-time (TOT) battalion volleys, for a total of 1399 rounds of DP ICM to extract the requisite amount of attrition on personnel in the assembly area, and using 784 Copperheads to extract a similar amount of attrition from the armored vehicles moving on the road. The 784 Copperhead rounds would be fired from two two-gun platoons or an average of 196 Copperhead rounds per tube, or over seven hours or approximately 25 rounds per tube per hour.

In the case of the daring thrust, the counter fire mission would not necessarily require the use of Copperhead rounds, and therefore could be accomplished by a combination of high explosive and dual purpose improved conventional munition rounds. A total of 6777 rounds would be required to extract the requisite attrition for the counterfire mission, given an overall target location error of 200 meters. Against the daring thrust, in which the Soviet doctrine does not normally include the units moving into assembly areas for optimum staging into the attack, but rather an attack from the march, approximately 366 CLGP rounds would be required to extract the requisite attrition on the armored vehicles. This reduced number of Copperhead rounds for the counter-mobility attack problem, when compared with that of the breakthrough, is simply due to the smaller size of the attack. The 366 Copperhead rounds translate into 92 rounds per tube over an approximate seven hour period, or approximately 19 rounds per tube per hour. All of these Copperhead expenditure rates are well within the Copperhead firing rate capabilities.

ARTILLERY ROUNDS BY TYPE REQUIRED TO EXTRACT ATTRITION AND DELAY SUFFICIENT TO BLUNT WARSAW PACT ATTACKS

WP ATTACK \ ARTILLERY MISSIONS	COUNTER BATTERY ROUNDS REQUIRED	COUNTER MOBILITY ROUNDS REQUIRED ZONE 2
BREAKTHROUGH	6938 HE 4626 DP ICM OR 1035 HE 690 DP ICM } VS TOWED CREWS 225 CLGP (VS SP)	0 HE 1399 DP ICM (PEOPLE) OR 784 CLGP (ARMOR) (196/TUBE)
MANEUVER BATTLE	4067 HE 2710 DP ICM No Need For CLGP	Very Limited Capability 732 CLGP (ARMOR) (92/TUBE)

ASSUMED CLGP P_{kss} = 0.33

This figure presents three options considered for an RPV designator given the ground speed of the RPV is 80 km/hr. The top timeline presents one concept for Zone 1 attack. The bottom two timelines presents Zone 2 "Race Track" and "Road Runner" operational concepts. The number of kills are assumed with a single shot probability of kill of 0.33 against a live target.

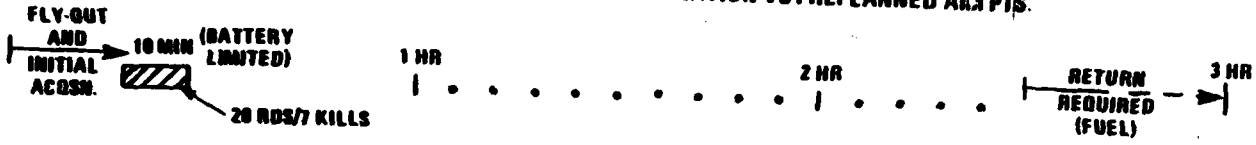
Total laser designation time available from a set of RPV batteries is an inverse function of the duration of individual designations. One designation technique which has been considered for use against targets in Zone 1 is continuous designation, while many Copperheads are fired from a large number of guns at maximum rates of fire. The rationale for this technique is based on the high density of targets in Zone 1 and the limited time available to stop them, but as the top timeline shows, total battery life is limited to a fraction of the available RPV flight time.

The middle timeline is for the search, orbit and designate technique of using the RPV in a "Race Track" concept permitting a possible 30 kills during a typical flight.

The bottom timeline illustrates the "Road Runner" technique, permitting a possible 50 kills during a single flight over Zone 2A.

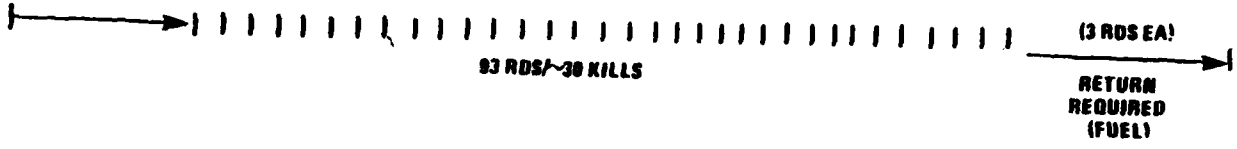
RPV DESIGNATIONS FOR COPPERHEAD AT 80 KM/HR GROUND SPEED

ZONE 1, CONTINUOUS DESIGNATION VS PREPLANNED AIM PTS.



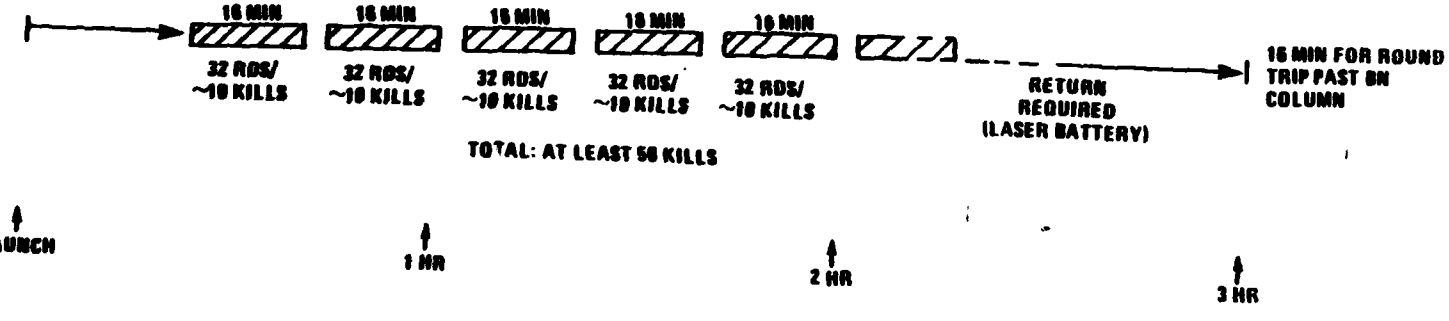
"RACE TRACK"

ZONE 2A, 10 SEC DESIGNATIONS VS TGTS FOUND NEAR PREPLANNED AIM PTS. FIRE 3 CLGP & SEARCH



"ROAD RUNNER"

ZONE 2A, 15 SEC DESIGNATIONS VS BN SIZED (~10 KM LONG) COLUMNS, USING PREPLANNED AIM PTS (NO SEARCH)



The implications of the Stand-Off Target Acquisition System, combined with the Remotely Piloted Vehicle and Copperhead, are summarized in the figure on the opposite page. For the breakthrough, without the use of these systems, some 70-100% of the artillery would be needed in Zone 2 to keep the presentation rate manageable and suppress the Soviet artillery. This assumes that the Soviets will, in fact, go into assembly areas prior to being staged into the Zone 1 attack, and that these assembly areas will be within U.S. artillery range. When the SOTAS, RPV and Copperhead are used in the Road Runner and Race Track concepts, some 30-50% of the artillery assets would be required to manage the armor presentation rate in Zone 1 and suppress or destroy the Soviet artillery without the need for assembly area restrictions. In other words, from 50-70% of the artillery assets would be available for usage in Zone 1 in this case.

For the Daring Thrust or maneuver battle in which the highest level of combat envisioned by the Soviets is the meeting engagement, some 30-50% of the artillery is required for the counterfire mission, and there is only limited capability to destroy, disrupt and disorganize the maneuver units in Zone 2. This latter limited capability essentially means that the Soviets still could stage in their main body attack force against the weakest points of the Blue defense in an optimum fashion. With the use of the SOTAS, RPV and Copperhead, some 40-60% of the artillery resources could totally control the presentation rate and suppress the artillery in Zone 2. Of this 40-60% only 5-15% would in fact be Copperhead rounds. The 5-15% range is based upon a single shot probability of kill of from .1 to .33 for Copperhead.

All of the implications resulting from this research must be taken in the light of the assumptions of the artillery duel model used in the beginning of the effort. For example, no time was allotted to either side for artillery movement for survivability, and no time was allotted for target acquisition cycle other than that for the Stand-Off Target Acquisition System.

The analysis of the Stand-Off Target Acquisition System, the Remotely Piloted Vehicle, and the Copperhead artillery round has indicated that for combat surge conditions such as the breakthrough and the meeting engagement will require more RPVs than are currently assigned in the Division Restructuring Study to the Divarty. For example, for the breakthrough, the Divarty RPV section plus the brigade RPV section and the division G-2 RPV section would have to be dedicated to locating and designating the artillery batteries and maneuver units prior to their entrance into Zone 1. The quick fire channels would essentially be set up between the RPV ground control station and the battery computer system (BCS) for the battery in which the two gun platoon assigned to the particular RPV was located. Therefore, for the breakthrough three RPV sections would be tied to four battery computer systems out of the eleven batteries assigned to defend in this zone.

IMPLICATIONS OF SOTAS/RPV/COPPERHEAD (SRC)

ATTACK

BREAKTHROUGH

WITHOUT SRC: 70 - 100% OF ARTILLERY NEEDED IN ZONE 2 TO KEEP PRESENTATION RATE MANAGEABLE - FURTHER REQUIRES SOVIET MANEUVER FORCE ASSEMBLY AREAS WITHIN ARTILLERY RANGE

WITH SRC: 30 - 50% OF ARTILLERY ASSETS REQUIRED IN ZONE 2 TO MANAGE PRESENTATION RATE AND SUPPRESS/DESTROY SOVIET ARTILLERY WITHOUT ASSEMBLY AREA RESTRICTIONS

DARING THRUST

WITHOUT SRC: 30 - 50% OF ARTILLERY FOR COUNTER BATTERY FIRES - ONLY VERY LIMITED CAPABILITY AGAINST MANEUVER UNITS IN ZONE 2

WITH SRC: 40 - 60% OF ARTILLERY RESOURCES (OF WHICH ONLY 5 - 15% ARE CLGP) TOTALLY CONTROLS THE PRESENTATION RATE

For the maneuver battle in which the highest level of combat is the meeting engagement, two RPVs, one from the Divarty and one from the brigade RPV sections, would be dedicated to locating and designating the maneuver units on the road and the artillery batteries in defile. Since the build-up of force for the maneuver battle is slower than that for the breakthrough with less units involved, the two RPV configuration is felt to be adequate. One RPV would be dedicated to accomplishing the Road Runner concept being tied to a single two-gun platoon via the battery BCS. The second RPV would conduct a combination of Road Runner and counterfire missions.

In all other conditions, the analysis indicates that the single Divarty RPV section would be adequate for the development of targets in Zone 2. These targets would include supply points, command posts, and artillery.

The final point relative to the RPV employment for attack in Zone 2 is that Soviet combat experience and current training stress that Zone 2 surge build-up conditions be conducted at night to allow the daylight hours to be used to secure the day's objectives. For example, the Combat in Tactical Example series of books used in the Frunzie Military Academy in Moscow indicate the majority of the exploitation and surge build-up examples being conducted at night during World War II. It is, therefore, important that the RPV associated with the SOTAS and the Copperhead elements of the total system have a night time capability.

The accompanying chart summarizes the payoff of using an integrated SRC attack in Zone 2A.

G. SUMMATION

The integration of SOTAS, FO RPV and Copperhead resources makes a significant improvement in the potential force multiplier of artillery usage in Zone 2 by extracting damage equivalent to Soviet neutralization on their combat units before they are committed to Zone 1. This significantly reduces the Soviets' high presentation rates into Zone 1 and, therefore, by their own analysis, would indicate that their losses in Zone 1 would be much higher than they could tolerate.

The force effectiveness analyses show a significant improvement when the FO RPV is cued by other target acquisition assets, such as SOTAS, into positions in which it can operate in the most efficient manner with artillery using Copperhead. In a potentially target-rich environment, such as is anticipated for Central Europe in the early 1980s, such an efficient usage of these systems could provide significant leverage against the massive quantities and improved quality of the weapons that the Soviets are currently infusing into their Warsaw Pact forces. For example, should the Soviets develop a dual purpose improved conventional munition capability for its artillery, this development could offset the NATO weapon advantages unless integration techniques such as presented here are developed in a comparable time frame.

One of the most important points as a result of this research is that the Zone 2 attack objective using SOTAS/RPV/Copperhead artillery assets should not be focused on killing a single tank, but rather rendering ineffective Warsaw Pact combat units. Therefore, when considering individual system cost, operational effectiveness and survivability, the number of combat units influenced by this combination of systems should be the basis upon which to make the assessment and not the number of individual tanks destroyed. If the Soviets decide that it is too expensive in terms of combat losses to move along roads when RPVs are designating for Copperhead rounds, the objective has been partially accomplished because it is impossible for the Soviets to meet the combat timelines with Zone 2 movement off-roads. The slower off-road forces are also ideal targets to be attacked by artillery delivered scatterable mines.

The remotely piloted vehicle appears to be the important link between the Stand-Off Target Acquisition System and Copperhead. However, due to the limited number of cannon launched guided projectiles, it may be more efficient to attack softer targets, such as the towed artillery and the maneuver units in assembly areas, with lower cost conventional munitions where the RPV is only used to locate the target for attack.

Based upon a survey of World War II tactics and current documentation used at the Soviet Frunze Academy, (i.e. Tactics in Combat - Examples) it is believed that the Zone 2 artillery attack opportunities will require both day and night SOTAS and RPV operations. Therefore, it is important that the RPV deployed in

SUMMATION

- SOTAS, RPVs AND COPPERHEAD REINFORCE POTENTIAL FORCE MULTIPLIER OF ARTILLERY ALLOCATION IN ZONE 2A
- FORCE EFFECTIVENESS ANALYSES SHOW SIGNIFICANT IMPROVEMENTS WHEN FO RPV CUED BY OTHER TARGET ACQUISITION ASSETS SUCH AS SOTAS
- ZONE 2A ATTACK OBJECTIVE SHOULD NOT BE TO KILL A TANK BUT RATHER TO RENDER INEFFECTIVE WARSAW PACT COMBAT UNITS. TO THIS END THERE IS A TRADE-OFF BETWEEN SOTAS/FO RPV SURVIVABILITY/COPPERHEAD PK AND THE NUMBER OF COMBAT UNITS INFLUENCED IN THE SURGE.
- FO RPV UNIQUELY SUITED TO ACQUIRE, IDENTIFY (?), ADJUST AND/OR DESIGNATE AND CONDUCT BATTLEFIELD DAMAGE ASSESSMENT IN ZONE 2A
- BASED ON SOVIET WW II TACTICS, ZONE 2A ATTACK OPPORTUNITIES WILL REQUIRE BOTH DAY AND NIGHT OPERATIONS
- SOTAS/RPV/CLGP PROVIDES SIGNIFICANT CAPABILITY IN ZONE 2A IF DIRECT FIRE WEAPON POSITIONS ARE SMOKED BY SOVIET ARTILLERY

Europe have a modular sensor package such as is currently envisioned by the U.S. Army Night Vision Laboratory. The sensor packages would have a television capability for daytime and a forward looking IR capability for nighttime operations. In addition, the package would have a laser designator for use on both the day and night sensor packages.

All systems have limitations. The SOTAS, RPV and Copperhead Zone 2 attack system also has limitations. The first obvious limitation is that of weather. The RPV and the Copperhead components of the total integrated system both require weather ceilings of about 2000 feet. In the Fulda area during the months of March through September, weather ceilings of less than 2000 feet occur less than 20% of the time. However, during the other months of the year, the probability of having a ceiling of less than 2000 feet occurs about 40% of the time. In addition, when there is bad weather, the majority of the fog and degraded conditions occur during the late night and early morning hours or at approximately the same time that the units would be moving along the roads for insert into Zone 1 at dawn. This is a real limitation of these integrated systems. However, the potential benefit offered by these systems in the early 1980's offsets this potential limitation.

There is currently a lack of a TRADOC-stated need for an RPV to operate at night. The review of the documents used at the Frunze Academy has indicated that the build-up for combat surges will probably take place at night. If the RPV is to be used as a Copperhead designation system, the night capability appears from a Soviet perspective to be essential.

There has been a traditional U.S. Army bias toward the use of artillery in Zone 1. This bias has been justified primarily because of the lack of accurate target location and designation in Zone 2. With the new target acquistion systems such as SOTAS and the RPV coming along in the early 1980's, there is a need to re-think the total combat problem in terms of the ultimate importance of the battle outcome due to the use of artillery in Zone 2 to influence the presentation rate of armored systems to Zone 1.

The last limitation of this Zone 2 attack configuration is a lack of concept verification for the Road Runner and Race Track concepts. Many questions have been raised with respect to the specific command and control requirements needed for these concepts to work properly. The problems appear not to be technological limitations, but rather required changes to the organizational and command and control structures. Prior to instituting these changes, it would appear to be very important to test these two concepts and develop hard data as to their potential utility to the overall battlefield.

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REVIEW AND INTEGRATION OF TARGET ACQUISITION AND DESIGNATION FO--ETC(U)
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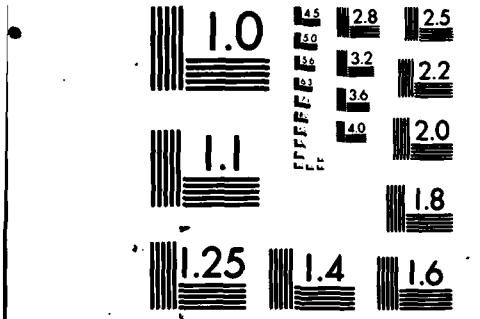


SOTAS/RPV/COPPERHEAD ZONE 2A ATTACK LIMITATIONS

- WEATHER
- NIGHT OPERATIONS (CURRENT LACK OF TRADOC STATED NEED)
- ARMY BIAS TOWARD ARTILLERY USAGE PRIMARILY IN ZONE I
- LACK OF "ROAD RUNNER" AND "RACE TRACK" CONCEPT VERIFICATION

This report, and its recommendations for a technique of attack in Zone 2A, is based on best available information, which includes some untested performance characteristics of all three of the elements used. So long as the Copperhead is a semi-active weapon requiring laser designation, the use of a small unmanned FO RPV to designate appears to be the only way to make these projectiles effective beyond ground line of site of the FEBA. Testing should be conducted to validate the employment concepts, with emphasis on command and control problems; and the system components performance and survivability characteristics.

SOTAS/RPV/CLGP ATTACK

NEED

TEST VALIDITY AND INTEROPERABILITY
OF "ROAD RUNNER" AND "RACE TRACK"
CONCEPT
IN TERMS OF THE REQUIREMENT TO FIGHT
OUTNUMBERED AND WIN IN ALL CORPS

This report fits with related products as shown on the accompanying chart.

In summation, this report addresses that piece of the total Fire Support Mission Area, the integration of the SOTAS, RPV and Copperhead. This basic research has been accomplished using a top-down view of the Army fire support role on the modern battlefield, starting off with FM 100-5 which presents the doctrine to thicken the defense by drawing down the reserves, and providing a heavy forward covering force. The FM 100-5 further assumes that both the direct and indirect firepower is highly effective, and that command and control and maneuver is accomplished in an expedient fashion. The actual game plan for the implementation of the concepts listed in FM 100-5 is only now beginning to take shape. To further understand the implications inherent in the FM 100-5 concept of operations, The BDM Corporation has developed the focus concept, which is designed to test, based upon threat actions, the level of maneuver and firepower risk that is acceptable for the V and VII Corps to keep the direct fire battle manageable. This concept further attempts to quantify the amount of artillery and Tac Air resources required to effectively lower the presentation rate to the direct fire weapons to a level that is acceptable to conduct the battle, stabilize the combat line of operations, and eventually defeat the threat. The focus concept further provides a structure within which to judge the contributions of each of the components of the Combined Arms team, in a manner similar to that of tuning each instrument within an orchestra.

The Fire Support Mission Area Study conducted for DARCOM/BSI in the August 1976 to February 1977 time frame highlighted the need for improved fire support resource integration and allocation to cope with the threat tactics. Enemy vulnerability time lines coupled with improving U.S. target acquisition, command, control, and communications, weapons and warhead lethality capabilities, were used as the basis for the recommended improvements in the Fire Support Mission Area. The research presented in this report is but one of the recommended system integration studies to come out of the Fire Support Mission Area. It was conducted in the September-October 1977 time frame, and developed the Road Runner and Race Track concepts for potential usage against armored vehicle attacks. The usage of these systems in Zone 2 or beyond line of sight appeared to be the most compatible usage when considering the enemy attack and U.S. response time lines. The Zone 2 usage of these systems was further emphasized when considering the need to control the Region 1 presentation rate, both with and without tactical aviation, coupled with the fact that the tactical aviation composition of the 1980's is scheduled to be heavily oriented toward A-10 aircraft with only limited capability to go beyond Zone 1. This concept, though having significant limitations, does provide a means to credibly counter the Soviet hardware improvements in terms of self-propelled armored artillery, as well as potential Soviet improvements such as improved conventional munitions. There is an immediate need to test to determine whether these concepts are in fact feasible as outlined in the study.

TOP-DOWN VIEW OF ARMY FIRE SUPPORT ROLE ON THE MODERN BATTLEFIELD

FM 100-5	THICKENS DEFENSE BY DRAWING DOWN RESERVES - ASSUMES FIREPOWER (BOTH DIRECT & INDIRECT) IS HIGHLY EFFECTIVE
FOCUS CONCEPT	DESIGNED TO TEST, BASED UPON THREAT ACTIONS, THE LEVEL OF MANEUVER AND FIREPOWER RISK THAT IS ACCEPTABLE FOR V & VII CORPS TO KEEP DIRECT FIRE BATTLE MANAGEABLE - ATTEMPTS TO QUANTIFY DEEP ARTILLERY AND TAC AIR EFFECTIVENESS IN LOWERING PRESENTATION RATE TO DIRECT FIRE WEAPONS
FIRE SUPPORT MISSION AREA STUDY	HIGHLIGHTED NEED FOR IMPROVED FIRE SUPPORT RESOURCE INTEGRATION AND ALLOCATION TO COPE WITH THREAT TACTICS USING ENEMY VULNERABILITY TIMELINES, AND IMPROVING TARGET ACQUISITION, C^3, WEAPON AND WARHEAD LETHALITY CAPABILITIES
SOTAS/RPV/CLGP STUDY	DEVELOPED "ROADRUNNER" AND "RACE TRACK" CONCEPTS FOR POSSIBLE ARMORED VEHICLE ATTACK BY THE INTEGRATED USAGE OF ARMY FIRE SUPPORT ASSETS - NEED TO TEST ACTUAL CONCEPT FEASIBILITY

CHAPTER IV

ARTILLERY AMMUNITION

REQUIREMENTS ANALYSIS

B. RESULTS OF HEADQUARTERS DARCOM MEETING

1. This task consisted of participating in, and reporting of, a meeting to:

   a. Review the use of the Fendrikov artifical dispersion methodology in comparison with USA Joint Munitions Effects Manual solutions and TACFIRE solutions, and to

   b. Discuss an unsolicited contract proposal for BDM to follow the initial aiming methodology work in a joint effort with AMSAA and the Field Artillery Center that recommends a more effective aiming doctrine than currently proposed for TACFIRE.

2. The following representatives were present at the meeting 25 October 1977 at Headquarters, DARCOM:

LTC W. Breen	DARCOM BSI
MAJ Kehres	FA School
B. Reichard	BRL
J. Kramer	AMSAA
J. Bloomquist	AMSAA
A. Golub	Consultant
B. Dunn	BDM
R. Sugg	BDM
W. Baum	BDM

3. LTC Breen opened the meeting with a summary of the background, citing:

   a. The description by BDM of five representative targets to be used in the initial comparison;

   b. The submission by the Field Artillery School of current TACFIRE attack of the five targets;

   c. The BDM comparison of rounds expended by U.S. and Soviet methodologies;

   d. The AMSAA evaluation of the same problems, with comments on the BDM work.

4. Dr. Dunn then reviewed selected viewgraph summaries of BDM analysis (see the unclassified summaries included at the end of this chapter and the classified summaries provided under a separate

cover). Coverage of the basic Fendrikov equations and approach was not repeated at this time, as the meeting members were familiar with the background. Dr. Dunn's conclusions were that, if fewer rounds of ammunition are required (10%-20% considered significant) to achieve the same percent damage on some targets, the subject of aiming technique is one that deserves further investigation. Such a comparative analysis of Soviet, other foreign and U.S. methodologies against a full set of potential targets on the modern Central European battlefield could lead to an improved (not necessarily Fendrikov) aiming doctrine for U.S. artillery. At this time the group discussion turned to potential future work and some of the points in the BDM unsolicited proposal "Assessment of U.S. Army Artillery Target Attack Procedures," distributed to the meeting members.

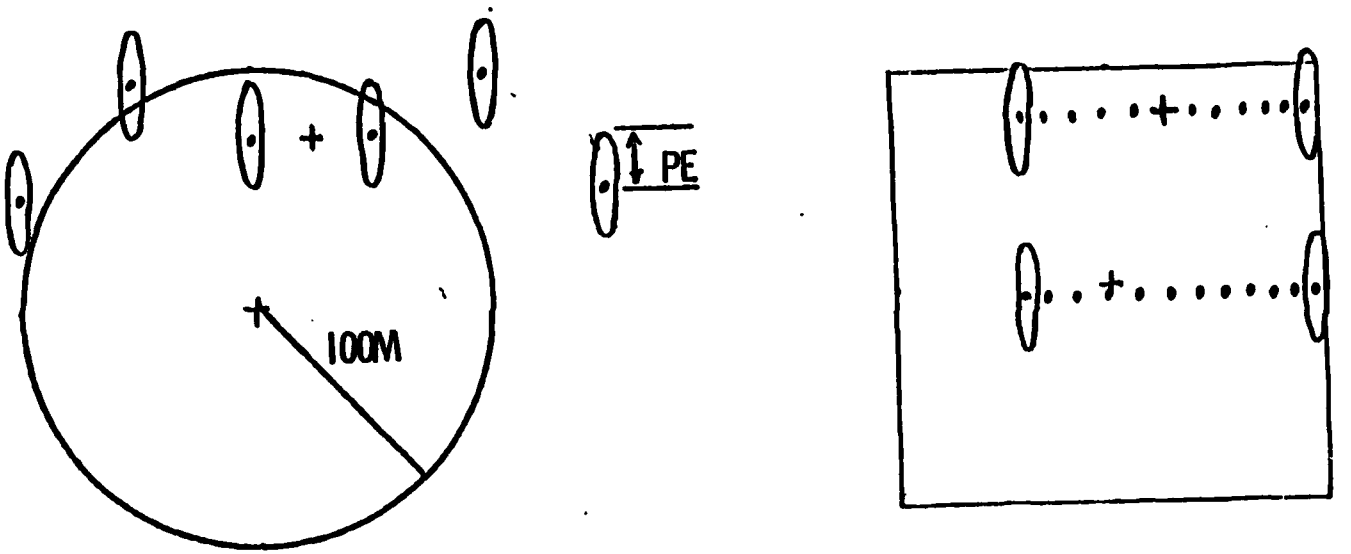
5. Mr. Kramer raised the question of whether the Soviets actually use Fendrikov and, if so, how would they do the necessary computations in a timely manner without an artillery computer. Dr. Dunn made the point that finding out if aiming can be done better, by any means, should be addressed first; then how long it takes could be addressed. There was concensus in the group that the Battery Computer System (BCS) under development, with the capability for handling individual piece corrections, probably could handle something like Fendrikov in responsive times. Mr. Kramer then stated that an area of interest would be what procedures would be most amenable to computer application, and to manual applications. Mr. Golub stated that any investigation should include a search for time-saving approximations to the improved effectiveness procedures.

6. LTC Breen closed the meeting by stating that both MG Hunt, BSI Director, and the FA School would need some time to respond to the ideas presented at the meeting. Mr. Kramer stressed that a DARCOM/BDM effort should not duplicate FA School work. MAJ Kehres stated that duplication was unlikely because the School addresses applications and does not have the staff capability to modify aiming doctrine as AMSAA does. He added that the BCS should be the baseline for any changes to aiming doctrine. It was agreed that a proper objective is the best aiming doctrine for BCS application.

COMPARISON OF FIRING TECHNIQUES

PARALLEL SHEAF

ARTIFICIAL DISPERSION



PERSONNEL CASUALTY LEVELS

STANDING	30%
PRONE	22%
IN FOXHOLES	4%

12 BATTERY VOLLEYS

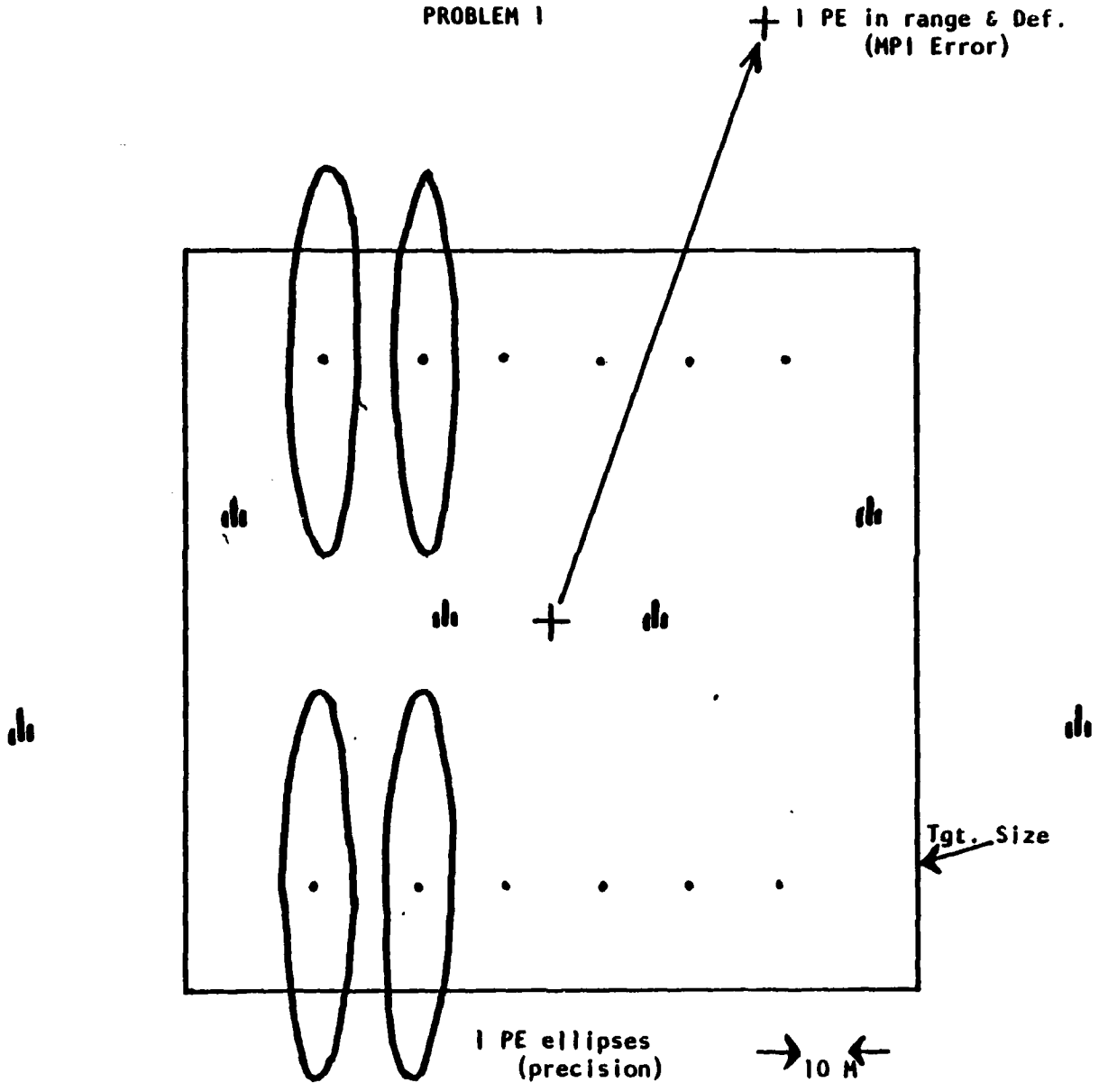
6 BATTERY VOLLEYS

PARAMETERS COMMON TO ALL PROBLEMS

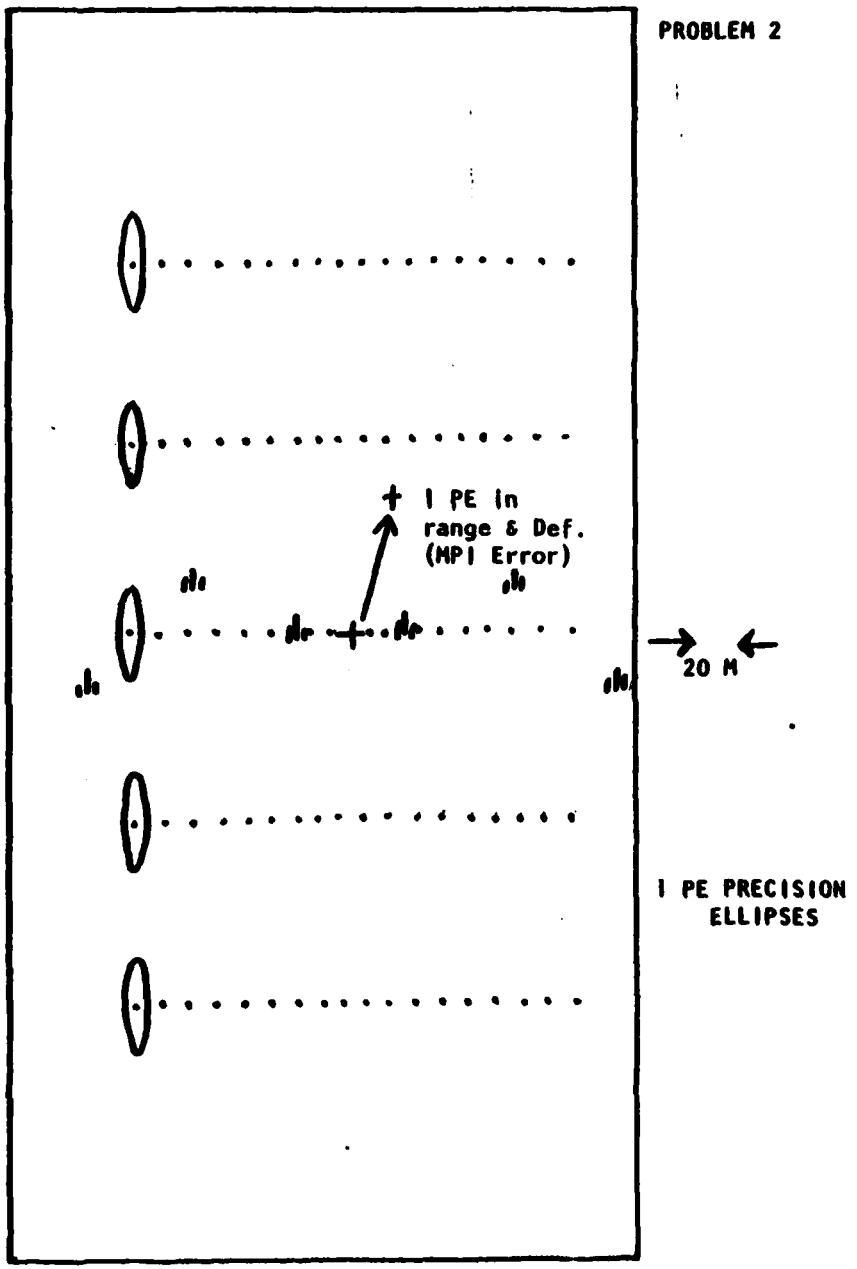
WEAPON:	HOWITZER, 155 MM: M109
PROJECTILE:	M107
EXPLOSIVE FILL:	COMP B
FUZE:	PROXIMITY M514 AIEI SET VT
DELIVERY TECHNIQUE:	INDIRECT FIRE, MET + VE
RANGE:	7000 METERS
KILL CRITERION:	ASSAULT - 5 MIN
BATTERY FORMATION:	6 GUN LAZY W

SPECIFIC PROBLEM PARAMETERS

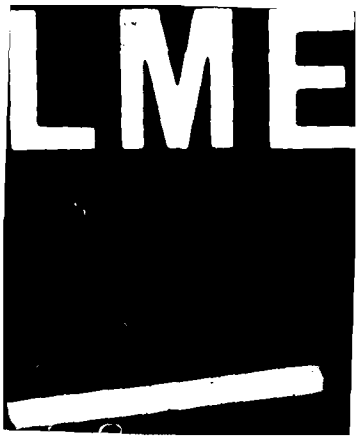
PROBLEM	TGT. SIZE	PERS. POSTURE	TGT. LOC. ERROR (CEP)	DESIRED PERCENT DAMAGE
1	50 M RADIUS	IN FOXHOLES	0	10%
2	650 MX300M	PRONE	0	30%
3	50 M RADIUS	"	0	45%
4	"	"	150 M	30%
5	"	"	150 M	15%



MPI PATTERN-SOVIET TECHNIQUE-TARGET AREA COMPARISON (LAZY W OVERLAY)



MPI PATTERN-SOVIET TECHNIQUE-TARGET AREA COMPARISON (Lazy W OVERLAY)


LME